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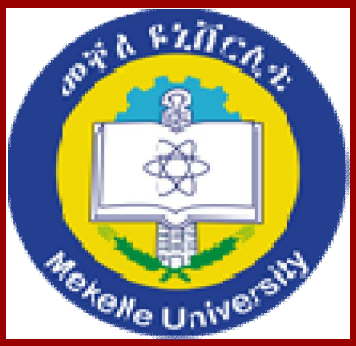

Impacts of Parcel-Based Second Level Landholding Certificates on Tenure Security, Investment and Land Productivity: In Tigrai, Northern Ethiopia

By:

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DECLARATION

I, **Kahsay Gerezihar**, do hereby declare that the thesis entitled ***"impacts of parcel based second level land holding certificates on perceived tenure security, investment and land productivity: in Tigrai, north Ethiopia"***, submitted to the department of economics, Mekelle university in partial fulfillment of the requirement of masters since in economics (development policy analysis) , is my original work and it has not be presented for the award of any other degree, diploma fellowship or other similar titles, of any other university or institution.

KAHSAY GEREZIHAR TSA-EDU

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Date _____

Place: Mekelle, Tigray, Ethiopia

CERTIFICATION

This is to certify that this thesis entitled ***"impacts of parcel based second level land holding certificates on perceived tenure security, investment and land productivity: in Tigrai, North Ethiopia"***, is an authentic work of **Mr. Kahsay Gerezihar** who carried out the research under my guidance. Certified further, to the best of my knowledge the work reported here in does not form part of any project report or thesis on the basis of which a degree or award was conferred on an earlier occasion on this or any candidate.

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ABSTRACTS

The question of whether the rural land registration and certification has an impact on tenure security, investment and land productivity or not, remains an important policy question. It is also a deeply sensitive political issue in present day of Ethiopia. Using household level data collected from 279 households of Raya Azebo district of Tigrai, north Ethiopia this paper investigates the impacts of parcel based second level land holding certificates on tenure security, investment and land productivity. Results of both probit model and IV-probit model consistently indicate that certificate positively and significantly associated with both specification of tenure security. in case of the investment impacts of certificate, The double hurdle model (probit specification for adoption decision and alternative truncated regressions on the actual zeros and predicted zeros from probit regression) and alternative Tobit specification are run. But the likelihood ratio test of model appropriates rejects the Tobit model in favour of the double hurdle model. This encourages the research to separately estimate adoption decision and intensity of adoption. Results from the double hurdle model shows certificate have positively and significantly correlated with decision to invest stone terrace and soil bound but negatively correlated with intensity of investment. While, there is no significant relationship between tree planting and second level land holding certificate but the parametric result confirms that certified households have significant gains from certification in terms of productivity. In sum, a result indicates that certificate has positive and significant benefits on both perceived tenure security investment decision and land productivity.

Key-words: Tenure Security, Investment, Land Productivity Double Hurdle, Land Certification, Tigrai

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ACRONYMS

AIC	Akaike's Information Criterion
ATT	Average Treatment Effect For The Treated
BoFED	Bureau Of Finance And Economic Development
CIA	Conditional Independence Assumption
CSA	Central Statistical Authority
DA	Development Agents
DID	Difference In Difference
ECSNCC	Ethiopian Civil Society Network On Climate Change
EEA	Ethiopia Economics Association
ELPA	Ethiopia Strengthening Land Administration Program
EPRDF	Ethiopian Peoples' Revolutionary Democratic Forces
ETB	Ethiopian Birr
FAO	Food And Agriculture Organization Of United Nation
FIG	Federation International Des Geometers
GIS	Geographic information system
GPS	Global Positioning System
HRSI	High Resolution Satellite Imagery
IV	Instrumental Variable
Kg	Kilogram
LAC	Land Administration Committee
MoA	Ministry Of Agriculture
OLS	Ordinary Least Square

PSM	Propensity Score Matching
SNNP	Southern Nation Nationalities and Peoples
SIDA	Swedish International Development Agency
ST	Stone Terrace
SWC	Soil And Water Conservation
TEPLAUA	Tigray Environmental Protection, Land Administration And Use Agency
TLU	Tropical Livestock Unit
TPLF	Tigray People's Liberation Front

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CHAPTER ONE

1. INTRODUCTION

1.1 Back Ground of the Study

Land is often described as the base of all wealth (Williamson et al, 2006a). Land is everything we need: food, shelter, fuel, metal etc. Our mere existence is closely related to land (Binns, 1953). Therefore it is often assumed that clearness regarding land tenure will strengthen an efficient and environmentally sound exploitation of this wealth. Land registration can provide important answer with regard to the question who 'holds' which unit of land. It is an important asset for any country, especially when the state of development demands an intensive use of relative scarce areas of land. (Otto, 2000)

A central argument put forward by many economists in defense of full-fledged private property rights is that better property rights institutions lead to improved economic outcomes (Knack and Keefer, 1995; North and Thomas, 1973; Acemoglu et al., 2001; Feder et al., 1988; Feder and Nishio, 1998). Economists such as De Soto (2000) and Braselle et al. (2002) have argued that the major barrier to prosperity in developing countries is the inability to convert property into usable assets, because of a lack of clearly stated legally recognized rights. However, the past empirical evidence on the importance of formalization of property rights in land are inconclusive, both on the overall effect of having property titles and on which dimensions of land rights are crucial.

Indigenous property right, in its various forms, by providing a set of well-understood and respected rules governing land use and transfer within the community, imparts a certain degree of tenure security. In this context, establishing a modern property rights system, without legally recognizing informal rights, may expand the scope for rent-seeking by land grangers (Atwood 1990).[1]

[1] (Atwood 1990) 1summarizes the argument as follows.

"Members of a local community may face far fewer risks of loss of land under the existing informal system than an outsider would face. In addition, while land registration might reduce the risks faced by an outsider, it may increase the risks and insecurity faces by local people as

Land tenure and property rights has been the most controversial and politicized issue in Ethiopian history. The tenant to land lord relationship that was generally prevailing in the southern part of the country was a major problem that triggered not only instability but also severely undermined agricultural productivity during the Imperial era. The then government had made certain attempts to address the problem of land tenure in the country.

Land registration was organized in Tigrai by Tigray People's Liberation Front (TPLF) already during the civil war from 1988 as a basis for land redistributions. At that time they provided a white paper to the owner with information about the name of the holder, family size, soil fertility status, parcel size in local units, boundary information on the parcel and neighbors of the parcels. This information was, however, not included in a central registry. The land registration and certification was started in 1998 and focused only on cultivated land in Tigrai. From the very beginning the aim was to minimize conflicts, increase tenure security and to upgrade the certificates and create registries (Nega and Atakilt, 2006). Organizational committees were established at woreda[2] and tabia[3] levels.

Since the low cost registration and certification begun in the region in the absence of a clear purpose and guideline, it has faced many shortcomings (Deininger et al., 2011). The first round of registration was not supported by maps of the registered holdings; and now regional states have found it necessary to undertake second level certification that is supported by maps. The updating procedure was in pilot in selected woredas (Raya azebo and Tahtay Adyabo); and that has also to be corrected. Current reports of the regions show that 99.5 % of all the holdings in Tigray have been registered at first level. The second level certification begun in the region with the help of foreign donors. The program departs from traditional titling interventions(the first phase) in a number of ways, in particular by 1) issuing non-alienable use-right certificates, rather than full titles; 2) promoting gender equity with joint land ownership by; 3) using a participatory and highly decentralized process of field adjudication; 4)how the holding was

family members or peripheral land claimants jockey to see in whose name a parcel will be registered…For many local people, therefore, registration can create rather than reduce uncertainty and conflict over land rights." (pp. 663)[1]

[2] A wereda (or woreda) is an administrative district of local government in Ethiopia. Which are made up of tibias(kebeles) are typically collected together(usually contiguous woredas) in to zones.

[3] Tabia is the lower administrative unit accountable to woreda administration.

acquired and file number of the book 5) it is based on cadastral system[4] (detail information about from whom, the period for which holding is granted, the " use pattern," the type of holding (i.e individual, organization, joint, communal, or state)) 6) it is parcel-based (each parcel have its own map rather than all parcel registration in one document) 7) it uses modern technologies including GIS and air photos, and major properties attached to the holding, and the rights and duties of the holder. The parcel based second level landholding certificates, on which the analysis is based, was officially launched in august 2011 and is viewed as parcel based second level land holding certificates.

The second stage certification was based on cadastral system which describes the land tenure in the country and must be able to keep pace with and support land-based development. A cadastre is defined in the Fédération Internationale des Géomètres (FIG) statement as:

> *"… normally a parcel based and up-to-date land information system containing a record of interests in land. It usually includes a geometric description of land parcels linked to other records describing the nature of the interests, and ownership or control of those interests, and often the value of the parcel and its improvements...." (FIG, 1995)*

Verifying empirically the impacts of modern land holding certificates on land tenure security, investment behavior and land productivity is a more relevant issue in the present day of Ethiopia. It is with this back ground that this study is initiated to fill the existing literature gap on this critical issue by examining the Ethiopia's experience and possible lessons for other similar areas on the impact of the parcel-based second level landholding certificates in Tigrai region, northern Ethiopia on perceived tenure security, land-related investment, and agricultural productivity.

[4] *The cadastral system is that combination of tenure records and the related description of the smallest individually definable land units over which rights can be held in a jurisdiction. Cadastral reform denotes the process of making the cadastral system better able to acquire, store, manage or disseminate the relevant information*.

1.2 Statement of the Problem

Although the impacts of land certificate on tenure security, investment and land productivity has been emphasized by number of scholars (De Soto, 2000; Deininger et al., 2011 and Holden et al., 2008), surprisingly little seems to have happened on the ground. This may even have led respected scholars to view interventions to register land as classic examples of a long discredited top-down approach to development rather than ways to empower land users (Easterly, 2008). Although it is recognized that the 'title-no title' dichotomy may be 'the wrong answer to the wrong question' (Bromley, 2008 and cited in Deininger et al., 2011), it tends to continue in the empirical debate in the literature.

With mixed outcomes of early attempts at land titling in Africa and considerable evidence linking the failure of the reforms to design and implement fresh and innovative methods that overcome the shortcomings of previous programs has generated renewed interest (Deininger et al., 2008). The Tigrai new parcel-based second level land holding certification program departs from the approach of traditional land titling interventions as it places larger emphasis, among other things, on promoting gender equity through issuing certificates with joint land ownership by spouses. Analyzing such pro-gender features the program in terms of the actual productivity benefits to women is, therefore highly relevant in this context.

A number of empirical Studies such as Deininger et al., (2011); Ghebru et al., (2008) and Place, (2009) indicate that the rural land registration and certification exercise in Ethiopia has shown important effects in building the sense of security in farmers that will in turn encourage farmers to invest more on their land holdings that positively affect natural resource conservation and sustainable land management. The studies such as Holden et al., (2008) and Place, (2009) also show that as a consequence of the registration and certification women are more empowered; and land holders who were reluctant or not willing to rent out their land holdings for fear of losing them are now confident to rent out because they can claim their lands back easily since their claims are supported by the holding of certificates. This research was tried to examine the ability of the parcel-based modern land holding certificates to achieve their desired effects. Whereas several of the previous studies focuses on first phase traditional land registration or the full land titling including right to mortgaging and land selling which is prohibited by law in Ethiopia.

Economists disagree on the impacts of land certification on the level of a country's investment. Several studies found that land titles enhance investment (Do and Iyer 2003; Field 2005; Feder and Nishio 1998). For instance, Ghebru et al. 2008; Deininger et al. 2007; Deininger et al. 2011; argued that land registration and certification increase the ability to use land and increase land level investments. However, other studies conclude that land titles do not significantly increase capital formation and investment (Kimuyu 1994; Place and Migot-Adholla 1998; Sellers 1999).

The relationship between land tenure security and investment is more complex than it appears. This is because of the nature of causality. Generally, many studies such as Feder and Feeny, (1991) and Jacoby et al., (2002) indicate that secure tenure increases incentives to undertake productivity enhancing land-related investments.

Several studies, for example (Bruce, 1988) have also questioned the direction of causality between tenure security and investment, arguing that tenure security may not stimulates investment to increase but rather investment may enhance tenure security. Thus, there still needs for proper understanding of the evolution of tenure security along with a careful empirical investigation of the links between tenure security and investment.

The novel aspect of this paper lies in the new approach it uses to address the impacts of the certificate on investment. Here the impacts of certificate for farmers decision to invest and how much to invest may not be the same. The decision to adopt may precede the decision on the intensity of use, and the factors affecting each decision may be different (Gebremehin et al., 2003). According to Holden et al., 1998; Pagiola and Holden, 2001; Holden and Yohannes, 2002; Holden and Shiferaw, 2002, Poverty and income related variables rather than certificate have impact on intensity of investment but tuner security that probably affect by certificate may affect household decision to invest. So estimating separately the impacts of the certificate on decision to invest and intensity of invest is highly relevant in this context.

Many studies showed that productivity of land directly related with degree of land improvements activites made by land lords. Another justification is in reference to the theory noted in the

literature that land right security is a necessary but not a sufficient condition for land improvement and farm productivity (Roth and Haase, 1998; Brasselle, Graspart et al., 2001). This means other factors are more influential to increase farm productivity such as supply of input, water, credit provision and other infrastructures should be given equal consideration so as to increase productivity of farm land. This raises a number of issues with potentially far-reaching consequences for policy, especially in predominantly agrarian economies in Ethiopia where rural productivity will need to improve significantly to overcome the wellbeing of the people.

In general, the question of whether the parcel-based second level land holding certificates has an impact on tenure security, investment and productivity or not remains an important policy question. It is also a deeply sensitive political issue in present day Ethiopia. To the best of my knowledge it has not be possible to locate any study that has systematically investigated the impacts of this new modern parcel-based second level land holding certificates on tenure security, investment and productivity in Ethiopia. It is with this back ground that this study is initiated to fill the existing literature gap on this critical issue by examining the impacts of parcel-based second level land certification on tenure security, investment and productivity in Raya Azebo district of Tigrai regional state.

1.3 Objective of the Study

The paper in general aims to investigate the impacts of parcel based second level modern land holding certification on farmer's tenure security, farm level investment and productivity.

1.3.1 Specific objectives

Furthermore, the paper incorporates the following specific objectives

- To analysis the link between land certification and perceived tenure security.
- To investigate the impacts of parcel-based second level rural land holding certificates on decision to investment and intensity of investment.
- To examine the impact of parcel-based second level land holding certification on land productivity.
- To point out important areas and modes of interventions for further policy development.

1.4 Hypothesis of the Study

H_1: Having parcel-based second level land holding certificate enhance perceived tenure security.

H2: Having a certificate for a farm plot enhances decision to investments on the plot in terms of decision to build soil conservation structures and stone terrace.

H3: Land certificate is relevant for adoption decision, but not relevant for intensity of adoption, conditioned decision is made.

H4: Causality may run the other way, That is, investment (visible investment such as planting of tree) may be undertaken to enhance tenure security rather than as a response to higher levels of tenure security.

H5: having parcel based second level land holding certification enhances land productivity

1.5 Significance of the Study

This study contributes to the literature in several distinctive ways. First, this study focuses on new cadastre system land holding program rather than one restricted to the first phase traditional land registration program. So the empirical finding of this study will provide information for the government, policy makers and international donors to observe the measures that should be taken to make the land administration work improve land-related investment.

Second, this paper focuses on the impact of granting new Parcel-based modern rural land registration and certification program. The program departs from traditional titling in different ways, in particular promoting gender equity with joint land ownership with spouse, using modern technology such as map, cadastre information system and support with GIS and air photos. So verifying empirically the theoretical relationship between modern rural land certification and investment behavior will have a far-reaching importance to take early appropriate policy measures since the scheme is a recent phenomenon in Ethiopia.

Furthermore, the land problem in the contemporary neoliberal globalization period requires a broader understanding than the past. Moreover, it is believed that the study can be considered as basis for further research and the output of the paper is used as an input (feedback) to policy makers in related domains for any other development agents.

1.6 Scope and Limitation of the Study

There are many study areas that the paper could deal with. But due to time and budget this research is limited only on the evaluation of the impacts of this program on household's perceived tenure security, decision to invest, intensity of investment and land productivity. The main target of the paper is estimating the impacts of Parcel-based modern rural land registration and certification on tuner -security, farm level investment and land productivity.

One limitation of the study is that it is based on cross-sectional data sets. With this it is difficult to control individual household and plot heterogeneity and time effects of idiosyncratic disturbances. Such problems can be addressed by using rich data set (panel). In addition, Baseline data before the implementation of the program was not readily available. So, important data before the intervention of the program were collected from households through recall which might be subjected to recall biases and inexact answers was the main challenge confronted by the research.

1.7 Organization of Study

The study is organized in to five chapters each with different characteristics. The first chapter deals with introduction part that includes back ground, statements of the problem, objective of the study, hypothesis, methodology, scope and limitation significance and organization of the study. The review of relevant literatures including theoretical review, conceptual frame works and empirical reviews has been discussed in chapter two. Chapter three dealt with site selection, data source methodology and econometric model specification and estimation strategies. Descriptive analysis, Estimation of the models and econometric results has been described in chapter four. The last chapter concludes the finding of the study and tries to suggest some policy recommendations. Supplementary information has also been appended at the end of the thesis.

CHAPTER TWO

2. LITERATURE REVIEW

This chapter briefly discusses the theoretical perspectives, conceptual frameworks of the models and empirical investigations related to the main themes of the investigations were reviewed to grasp some idea about what factors determining different country's tenure security investment and productivity. The emphasis of this chapter is to give a general impression on the link between certificate and tenure security, investment and land productivity.

2.1 Theoretical Review

2.1.1 Terminology and Definitions

Land:-Land is often described as the base of all wealth (Williamson 1997). Land gives us all we need: food, shelter, fuel and metal etc. Our mere existence is closely related to land (Binns 1953: 1). Therefore it is often assumed that clearness regarding land tenure will strengthen an efficient and environmentally sound exploitation of this wealth (Jaap Zevenbergen, 2002).

Land Registration:- The International Federation of Surveyors (FIG) defines and cited by Jaap Zevenbergen (2002) "Land registration is the official recording of legally recognized interests in land and is usually part of a cadastral system."

Land Parcel: - It refers to a single area of land, or more particularly a volume of space, under homogeneous real property rights and unique ownership.

***Tenure:* -** The Food and Agriculture Organization of United Nation (FAO) defined Tenure as "the relationship, whether legally or customarily defined, among people as individuals or groups, with respect to land and associated natural resources. Rules of tenure define how property rights in land are to be allocated within societies. Land tenure systems determine who can use what resources for how long, and under what conditions" (FAO, 2003).

***Tenure security:* -** FAO also defined secure tenure as related to the degree of recognition and guarantee of land use rights.

Title (registration): - According to the food and agriculture organization (FAO) Title registration is a system for improving the quality of ownership and proof of title. There are broadly speaking two parts of the register. The first is a map on which each parcel is demarcated and identified by a unique parcel identifier. The second is a text which records details about the title, the owner and any rights or restrictions associated with the parcel's ownership such as restrictive covenants or mortgages. Under a title registration system a transfer of the property simply results in a change in the name registered. A division of the land or alteration of the boundaries requires amendment to the plan and the issue of new documents or certificates. The official title registration record is definitive (UNECE 1996).

2.1.2 Land Rights: Delineation

For many people, land rights and their protection are central to life. But what are 'land rights'? More particularly, in the setting of this study, what human rights are recognized to land, or related to land?

In Ethiopia, both by incorporation of international agreements (Article 9.4) and inclusion of specific provisions (often identical in language to the international instruments), the current Constitution includes both general human rights related to land, i.e., to due process, equal protection and nondiscrimination (Article 25), and specific rights for women (Article 35.5) and other groups (Article 40).

But, quite unusually among the nations of the world, Ethiopia's Constitution also grants actual rights to rural land (Article 40). Of course, as soon as that is said, it is necessary to ask what such a right entails. And, more generally, in order to provide the most elementary basis for this paper, we must distinguish between different 'rights' in land. For the bizarre and diverse nature of land rights, and the ability to fragment them in novel ways, appears to be limited only by failure of human imagination. In addition, each of these rights may be held by one or more different parties. For example, the right to use the surface may be owned by one party, granted conditionally to another, leased on to several others, future interests assigned to yet others, and taken at any time in whole or part by the State. Thus, what is sometimes called the 'bundle' of land rights is, in almost all cases, fragmented and distributed over many holders so that an individual's rights in a particular parcel of land are actually quite restricted and limited by the rights of the State and other parties. Conflicts between all those holders of rights are, of course, common.

The right to ownership of rural and urban land, as well as of all natural resources, is exclusively vested in the State and in the peoples of Ethiopia. But then reserves to three classes of people specific rights to land: 40.4. Ethiopian peasants have the right to obtain land without payment and the protection against eviction from their possession. The implementation of this provision shall be specified by law; 40.5. Ethiopian pastoralists have the right to free land for grazing and cultivation as well as the right not to be displaced from their own lands. The implementation shall be specified by law; 40.6. Without prejudice to the right of Ethiopian Nations, Nationalities, and Peoples to the ownership of land, government shall ensure the right of private investors to the use of land on the basis of payment arrangements established by law. Particulars shall be determined by law.

It is important to note that each of these rights is hedged by the last provision in each paragraph, that the particulars of each right are to be determined by law. To date, these Constitutional provisions have been further delineated by two Federal laws and the different laws and regulations of each of the Federal States.

By the Federal land laws, the Federal government's Constitutional authority to proclaim laws related to land (Article 51.5) has been partially delegated, within specific though broad guidelines, to the States. This has allowed significant differences in State laws. The Constitution also allocates the authority to administer land and other natural resources in accordance with Federal laws directly to the States (Article 52.6).

Acknowledged in the successive Federal land laws and subject to limitations in State laws, as a specific example, the laws of Tigray State both assure and limit inheritance of land. The State's goal is clearly to balance increased certainty of an adequate payback period and, thus, the holder's investment in land (Gebremehin, 2003; Atwood, 1990; Barrows and Roth, 1990, Ghebru et al. 2008, deininger et al 2011), with the social welfare principle that the neediest descendants obtain the parents' very limited land. The need to balance such competing policy principles is prevalent in land rights legislation, but when eventually challenged the basic right may be determined by the courts to limit policy choices.

2.1.3 Land Tuner in Ethiopia History

Land tenure and property rights has been the most controversial and politicized issue in Ethiopian history. The tenant land lord relationship that was generally prevailing in the Southern part of the country was a major problem that triggered not only instability but also severely undermined agricultural productivity during the Imperial era. The then government had made certain attempts to address the problem of land tenure in the country (Ethiopian Civil Society Network on Climate Change (ECSNCC), 2011)

In 1961 a Special land Reform Committee was constituted to study the different land tenures in Ethiopia by the Order of His Imperial Majesty. After conducting its study, the Committee recommended that ceilings or a maximum limit on individual ownership be fixed; a tenancy legislation that governs the relationship of the tenant and the landlord be enacted; antiquated tenure systems like the *gult (*a tenure system that was prevalent in the *rist* or communal system in the northern part of the country) be abolished; and the land tax system be improved. In 1964 Land Reform Authority was instituted to implement these reform measures recommended by the Special Land Reform Committee. However, the Land Reform Authority could not even implement the reforms recommended by the Special Land Reform Committee. The 1974 mass uprising and revolution broke out and the government was deposed in 1974 by a military coup. Several causes have been cited as causes of the 1974 revolution but many writers agree that the land issue was the most significant cause (J.cohen and D.weintraub,Van Gorkum,Assen (1975), J.Hobenand Dessalegn Rahmato,1993)

The military government, called the *dergue*, declared socialism as its guiding principle and took a radical step in land reform. In 1975 it proclaimed the Public Ownership of Rural Lands Proclamation No.31/1975. Under the Public Ownership of Rural Lands Proclamation all forms of traditional land tenure except pastoralist land tenure were abolished. All rural lands came under state ownership. All rural lands that were owned by landlords were distributed to tenants. Previous land owners were also given a right to retain the maximum amount of land allowed under the proclamation where they prefer to engage in farming. The maximum size of land holding a person could hold was limited to 10 hectares. All rural lands in the *rist*/communal land tenure system areas also became under private holdings except some communal lands used

communally by the community for grazing, forest, and other purposes. The government gave land administration and redistribution powers to peasant associations that were formed in every *kebele*. Furthermore, the redistribution was not systematic and there was no regulation that guided the actors. Fragmentation of land holdings and natural resource degradation, loss of productivity and other related issues emerged as new land reform issues (Ethiopian Civil Society Network on Climate Change (ECSNCC), 2011)

The military government was overthrown in 1991 by the Ethiopian Peoples' Revolutionary Democratic Forces (EPRDF). The EPRDF declared that it will adopt a free market economic policy. The land reform question was again on the agenda. The debate at this time was whether land should be public or private. Government and its supporters were in favor of state ownership while opposition and academics were in favor of privatizing land. (Ibid)

In 1995 the Federal Democratic Republic of Ethiopia Constitution was promulgated. Under the constitution land remained under state ownership. The EPRDF continued the policy of the previous government concerning rural lands and it conducted a comprehensive redistribution in the country. In 1997 it enacted the Federal Rural Lands Administration Proclamation No.89/1997 that gave power to regional states to make their own land administration laws within the framework of the federal land administration law. Under Proclamation 89/1997, land holders were given some transfer right such as renting, gifting to a family member, and bequeathing to a family member. The land legislation also reaffirmed that regional states could conduct specific or comprehensive redistribution of land. Tenure insecurity that hovers over farmers continued to be the source cause for low productivity and hunger, damage to land and natural resources. The land reform debate continued focusing on the security of tenure of farmers and relating issues of productivity, fragmentation, poverty, natural resource degradation, etc.4 On the basis of the federal Land Administration Proclamation No.89/1997, all the four regional states enacted their land administration laws and the Tigray Rural Lands Administration Proclamation No.23/1997 is held. In order to ensuring tenure security, the tigray regional states started registration and certification of rural land holders. (Ibid)

The Federal Government then issued the Federal Rural Lands Administration and Use Proclamation 456/2005; and the four regional states also harmonized their land Administration laws with the federal land law. This legislation is not fundamentally different from the previous one but it provides for the registration and certification of land holders, and also it informs the regions to prepare land use plans. It still did not prohibit redistribution of rural land holdings as the regional states do. The registration and certification exercise has been seen as a factor that insures tenure security and different donors, like Swedish International Development Agency (SIDA) cooperation and USAID assisted the rural lands registration and certification process in the Amhara, Tigray, Oromia, and SNNP Regional State. (Ibid)

Expropriation of lands has also become one of the major source of insecurity as a result of the government's free market policy and encouragement of investors. Government agencies were expropriating land without paying compensation since land is said to be the property of the state.

To address this problem, the federal government issued Expropriation of Land Holdings for Public Purposes and Payment of Compensation Proclamation No.455/2005. Under this proclamation land holders whose lands are expropriated are entitled to get compensation for the property they lose and displacement compensation for the land they lose. In practice, however, many expanding towns and regional government agencies are still taking lands without payment of displacement compensation or making substitute land available to the farmers whose lands are taken. (Ibid)

2.1.4 Land Tuner in Tigrai

Land registration was organized by Tigray People's Liberation Front (TPLF) already during the civil war from 1988 as a basis for land redistributions. At that time they provided a white paper to the owner with information about the name of the holder, family size, soil fertility status, parcel size in local units, boundary information on the parcel and neighbors of the parcels. This information was, however, not included in a central registry. The land registration and certification was started in 1998 and focused only on cultivated land in Tigray. The aim was to minimize conflicts, increase tenure security and to upgrade the certificates and create registries (Nega and Atakilt, 2006). Four different forms were used in the process. Form 1 was used for

collection of data in the field, Form 2 was the registry book where the information was recorded at community (tabia) level (a copy of this book was also kept at woreda level), Form 3 was the land certificates given to the landholders, and Form 4 was to be used for land transactions.

It was the Bureau of Agriculture and Natural Resources that was responsible for the implementation. Organizational committees were established at woreda and tabia levels. At tabia level they typically consisted of the local agricultural development agent, the tabia leader and elders from the community who had experience from participation in earlier land redistributions. In addition technical support was provided by youth that had been trained for six months (Haile et al., 2005). For more detailed description of the process we refer to Haile et al. (2005) and Nega and Atakilt (2006).

By 1999 more than 80% of the landholders in Tigray had received land certificates. Ideally plot borders were identified and more clearly demarcated where this was needed under the presence of all relevant neighbors. No maps of the plots were made. Households were then given the land certificates (Form 3) that were a one-page sheet with the name of the household head, the list of plots that the household owned, the size of the plot, the land quality, the name of the location of the plot and the names of the neighbors of each plot. But this certificate was not yet achieved its prior objectives as expected and the regional government in collaboration with federal government diced to implement the new parcel base d second level land holding certificate in the region. The updating procedure was in pilot in to selected woredas of tigray.

2.1.5 Conducting Second Level Rural Land Registration and Issuance of Certificates

Tigray Environmental Protection, Land Administration and Use Agency (TEPLAUA) have been implementing Ethiopia Strengthening Land Administration Program (ELAP) with financial support of USAID and technical assistance of TETRA TECH ARD in Raya_Azebo and Tahtay Adyabo wereda of Tigray Regional State since January 2009.

ELAP is successor project of Ethiopia Strengthening Land Tenure and Administration program (ELTAP) that was implemented in the region. The objective of ELAP is to assist the government of Ethiopia strengthen and enhance rural land tenure security and administration through improving the legal framework; advancing public awareness in land rights and obligations and

the major provisions of land administration and land use laws; and promoting domestic and foreign investment in land through improved land administration legislation and registration and certification process.

Parcel based rural land registration and cadastral surveying as well as issuance of user's certificate in the two focus wereda of ELAP were the key task of the projected implemented by TEPLAUA. In the implementation plan of ELAP, it was target to survey and registered 35,000 parcels in each of the two focus woredas but the accomplishment was found to be 24,020 and 5,628 in Raya Azebo and Tahtay Adyabo wereda respectively. From the total 29,648 parcel surveyed about 21 544 certificate were issued to the land holders in Raya Azebo and 3,870 in Tahtay Adyabo wereda.

In addition, contract workers surveyed and registered the existing and potential investment lands in the two focus woredas. In Tahtay Adyabo wereda 1,481 ha of landholdings of 15 investors growing oil crops and 3,932.8 ha of land potential for oil crops/cereals production and 1,331.14 ha of land with potential for fattening and dairy production were surveyed. In Raya Azebo wereda, 814 ha of land allocated for 8 investors and 330 ha of land with potential for vegetable/cereal crops is surveyed and registered. The indicated low performance of Tahtay Adyabo wereda is due to land administration problem and early start of rainfall.

To complete some of the unfinished certification program initiated in ELTAP woredas within the allocated limited budget, training was given to the permanent surveyor and registration staffs of the six ELTAP focus wereda land administration desk and for one contract crew assigning to conduct the task in each of the woredas.

Moreover, an assessment was conducted by the regional staffs in the six woredas of ELTAP and the result of the assessment indicated that almost all the data are available. Using the result of the assessment one kebele was selected from each of the woredas to start initiate second level certification. But the field work of collecting necessary information for the preparation of base map and processing of the data was started only in four woredas (Enderta, Hawizen, Adwa, and Tahtay Koraro).

2.2 The Conceptual Framework

The empirical literature on land tenure begins with a simultaneous equation model based on an underlying household optimization problem where households perception of security, investment and agricultural productivity (Feder and Onchan, 1987; Feder and Feeney, 1993; Foltz et al., 2000; Zikhali, 2008). In this model tenure security indicator (T), investment (I), productivity (Y) are endogenous variables that depends on a set of exogenous variable (X and W) associated with household and plot characteristic respectively.

Depending upon the empirical situation, having the certificate (C) may be exogenous or endogenous in the model. We assumed household specific unobserved characteristics will not affect impact of certification as this intervention is exogenous to individual households and all households within a village are well aware that they will receive the certificate since it is compulsory program.

With considered to be exogenous, the hypothesized general structural model for this study is adopted from Foltz et al., 2000 and Zikhali, 2008 with modifications as follow:

$$T = T(C, I, W, X) \quad (1)$$

$$I = I(T(C), X, W, I_P) \quad (2)$$

$$Y = Y(I(C), W, X) \quad (3)$$

Where C =1 if the household have the second level land holding certificate for the plot, 0 otherwise. I is the type of investments, measured length of soil conservation structures, stone terrace constructed and number of tree planted, in the last 18 months. T is an indicator of perceived tenure security. Perceived tenure security is expected to be affected by C, the dummy indicating whether the household got the parcel based landholding certificate or not. We maximize on the information we have by having dummies that capture the different types of tenure security indicators. We also include an interaction of a dummy that captures whether the household believes investing on land enhances tenure security with investment levels to investigate whether believing investing on land enhances security and actually undertaking investments affects perceived tenure security.

X is a vector of the household's socioeconomic characteristics, which include for example, gender, age and education of household head, household composition, social capital indicators, agro-ecological difference control variables such as village dummy, involvement in off-farm activities and W is parcel characteristics such as size and steepness of parcel, different input use statues and initial endowment (intensity) of soil conservation, stone terrace structures and number of tree planted in plots socio-institutional and market access factors are control. The public investment variable (I_P) should both control for its direct impact at plot level and its indirect crowding in or crowding out effects on private investment (Ghebru et., Al., 2008).

In light to the above concept, one can hypothesis that having parcel-based second level landholding certificates enhance tenure security, which is designated as:

$$\frac{\partial T_i}{\partial C} > 0$$

And that for house hold who believe investing on land enhances tenure security, that is investment (visible investment such as planting of tree) may be undertaken to enhance tenure security rather than as a response to higher levels of tenure security. This hypothesis can be designate as:

$$\frac{\partial T}{\partial I} > 0$$

The empirical study made by (Holden and Yohannes, 2002) on tenure security and investment supports this argument:

Consistent with the theoretical postulation it is possible to hypothesis that

$$\frac{\partial I}{\partial T} > 0$$

$$\textit{And assuming that certificate enhance tenure security we have}$$

$$\frac{\partial I}{\partial T}\frac{\partial T}{\partial C} > 0$$

Tenure security is more important when we consider medium to long term investments (Holden and Yohannes, 2002). This has been the justification for most researchers' approach of looking at the impact of tenure security on more long term investments such as tree planting and construction of conservation structures (Besley, 1995; Hayes et al., 1997, Holden et al 2007)

Where Y in equation 3 is the value of yields in Ethiopian birr per ha/tsimdi. In line to the theoretical postulates, one can hypothesize that investment on land enhance land productivity.

$$\frac{\partial Y}{\partial I} > 0$$

In the other way it is possible to hypothesize that land certification have positive impact on land productivity indirectly through the investment variables that possibly is affected by certification.

$$\frac{\partial Y}{\partial I}\frac{\partial I}{\partial C} > 0$$

2.3 Empirical Findings

This paper builds off of the existing literature to further examine the effects of parcel-based second level land holding certificates programs and their impact on investment and productivity.

Studies that have examine the link between land certification and its impact on tenure security, investment and productivity have done so with solid theoretical reasons why we should expect this relationship to exit, but have found an even result in practice. Pender and Kerr (1994) in India, found, that any differences in credit use between titled land and assigned state land were due to the difference in quality of the land and not to increased security of tenure as a result of the land titling. Similarly, Carter and Olinto (2003) in Paraguay found that land titling increased the incidence of credit but that this credit access was affected by the size of the farm because the transaction costs were a larger percentage of the value of the land for small farmers. A study by Alston et al. (1996) in Brazil also found that the distance from the market center and the duration of occupation were significantly determined to be related to the incidence of title. Title was required in Brazil to provide security in the contested regions close to the market center. At the same time López (1996) found that 8% more titled farmers than the untitled ones received credit and the titled farmers received almost 4 times likely what the untitled farmers received in credit.

Gebremehin et al (2003) propose that Perceived tenure security is important for making land investments and use of improved farming practices. However, an investment in land does not appear to have significant effect on perceived tenure security of farmer's results. This implies that, there is a need to improve tenure security of farmers in order to encourage land investment.

Burnod et al (2012) which examines the Malagasy land reform ongoing since 2005 belongs to this new generation of land reform and its impacts on tenure security through the concept of legal empowerment. Holding a certificate has the advantages, compared to petite papers, to reduce the diffuse sense of tenure security and, compared to land title, to be more accessible. In addition, the land reform and notably the decentralization of land management has also contributed to reduce the sense of tenure insecurity through a legal empowerment process.

Similarly, Holden and Yohannes (2002) did not found evidence of tenure insecurity having a negative effect on investment in tree in south Ethiopia but found that, poverty have negative impact on investment. Tenure security may there for neither be necessary nor sufficient condition for investment. On the other hand, Deininger and Jin (2006) found that transfer rights to land as well as tenure security were investment-enhancing based on a survey in 2001 of the four major regions in Ethiopia. In their study they distinguished between highly visible (trees) and less visible (conservation structures) investments. Recent evidence from a broad cross-sectional survey in Ethiopia also indicates that the recent land certification may have enhanced investment (Deininger et al. 2007). As the same time Foltz et al. (2000) in Nicaragua found that, There is no significant relationship in the data between investment (defined as either total investment or just agricultural investment) and land rights and household characteristics, tenure status is significantly related to the number of trees on the property (a form of long-term land investment).

Deininger and Ali (2007) also analysis this using information on parcels under ownership and usufruct by the same household from a nationally representative survey in Uganda, this paper quantifies the investment impact of property rights insecurity arising from overlapping land rights rather than comparing titled and untitled land. The case of Uganda, a country where overlapping property rights, many of them established a long time ago, are very common. The authors found that tenure insecurity has statistically very significant effect on investment and thus the productivity of land use. The fact that both the sample and the point estimates obtained are several times larger than what is reported in the few comparable studies suggests that, in the case of Uganda, higher tenure security could considerably affect agricultural performance. The effects of tenure security and investment on tenure security is mixed for example with no significant effects

in Somalia (Roth et al., 1994b) and Senegal (Golan; 1994), but Positive effects in Uganda (Roth et al., 1994a) and Rwanda (Blarel, 1994) on certain types of investment.

Pinckney and Kimuyu (1994) try to compared titled areas in Kenya with untitled areas in Tanzania and found that there was no difference in the number of transactions, formal or informal, between the two locations. Platteau (1996) questioned the applicability of the evolutionary theory of land rights in the Sub-Saharan African context despite the fact that other researchers such as Feder and Nishio (1999) presented empirical evidence from several other countries in other regions, of titled farmers receiving more credit and investing more on their land than untitled farmers. Platteau (1996) based his critique on empirical research done by Land Tenure Center (LTC) (1990), Roth et al. (1994a; 1994b), Migot-Adholla et al. (1994a; 1994b) and others in the Sub Saharan African context. These studies were focused on access to credit and the corresponding impact on agricultural productivity. Place et al. 1998 In Kenya found that, titled farms had higher net returns per hectare, but when the effects of size and market access are separated out, it becomes clear that it is these factors, rather than title, that are responsible for the correlation. Place and Migot-Adholla (1998), re-examining data from a study performed in 1988 in Kenya, found insufficient evidence to support any significant effect of registration and land titling on the perception of security of tenure, on the use of credit by landowners, on agricultural productivity and the reallocation of land.

Deininger et al. (2006) also found that insecure tenure (as measured by past redistribution) encourages planting of trees but discourages terracing in Ethiopia. At the same time, both the perception of future risk of redistribution and lower levels of transferability clearly reduce the propensity to invest, especially in non-visible activities that can enhance future productivity. The effects found are not only highly significant statistically but also of considerable magnitude. An IDB study (1986), performed in Jamaica, found similar result that farmers on titled land had planted almost twice as many permanent and semi-permanent crops as those on untitled land in a voluntary sporadic titling process.

De Soto (1989) presented his study on the case of Peru and found that, Tenure security was deduced from the fact that 13% of the lots on informal untitled land were involved in litigation. The titled land was also valued nine times higher than that of the untitled land. Bellemare (2012)

in Madagascar found that formal land rights (i.e., land titles) have no impact on productivity, but that informal land rights (i.e., landowners' subjective perceptions of what they can and cannot do with their plots) have heterogeneous impacts on productivity.

In theory, there is a general consensus that making land rights more secure and transferable would promote investment incentives and efficient use of resources. This conventional view has three major justifications. First, it is believed that secure rights provide a guarantee to farmers that the fruits of their investments will not be appropriated by government or other agents. This encourages them to make long-term investments on their land (Atwood, 1990; Feder and Feeny, 1991; Besley, 1995). The second effect works through the credit market. As pointed out by Feder and Onchan (1987), security of ownership improves chances of obtaining loans to finance agricultural investments. This is because ownership rights facilitate the development of an efficient land market. This reduces information costs for the lender and provides the basis for using land as a collateral asset.

On the other hand several studies also argue that causality may also run the other way round. Long term investments on land, particularly planting trees enhance tenure security (Atwood, 1990; Besley, 1995; Otsuka et al., 1997; Brasselle et al., 2002). Brasselle et al. (2002) allowed for endogeneity between land tenure security and investment incentives in Burkina Faso point to flaws in the design and concept of empirical tests that both support and question the positive link between individualized tenure and security of tenure and then to investment on land. They opine that there is always some form of endogenous tenure underlying the titling and this must be accounted for and controlled before statements about the correlation between security of tenure and investments can be made. The researchers attempt to control for this effect by choosing for analysis newly settled communities where no endogenous tenure and therefore no tenure security would have existed prior to the titling. Then the researcher found that investments increased security of tenure and not the other way around. The study was performed in a community of Burkina Faso in Africa where there was no land market so that the impact on transactions could not be investigated. Even the tenure security indicators that are used my not appropriate indicators for tenures security.

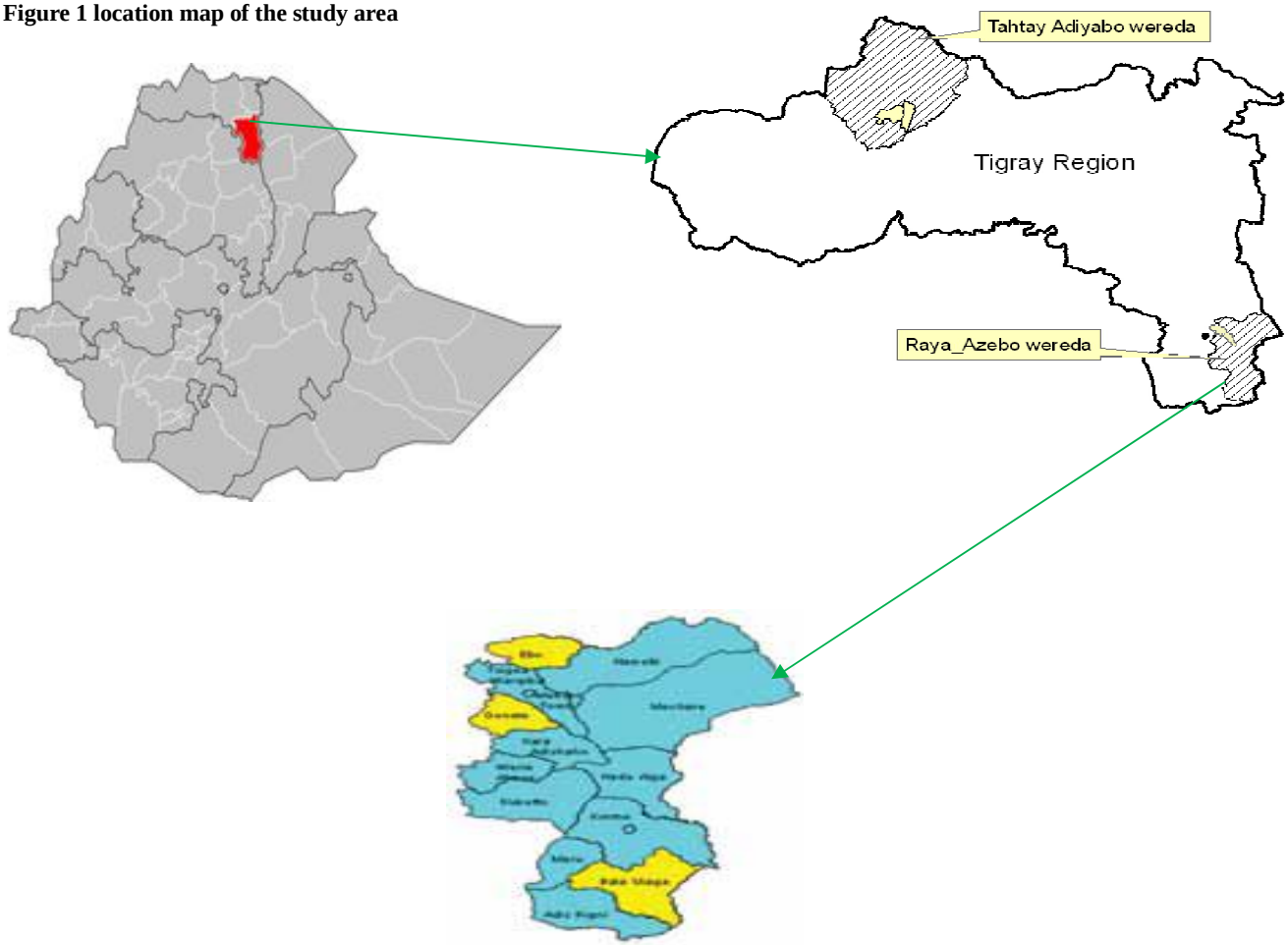
CHAPTER THREE

3. METHODOLOGY OF THE STUDY

3.1 Description of the Study Area

Tigrai national regional state is located in northern part of Ethiopia the region is boarder by Eritrea to the north, Sudan to the west, afar regional state to the east Amhara region to the south. It covers an area of approximately 54,572 square km. the altitude of the region varies from about 500 meters above sea level (masl) in the north-east to almost 4000 masl in the south-west. The agro-ecology of the region is broadly categorized in to lowland (kola- less than 1500 masl), midland (woina-degua-1500 to 2300 masl), and upper highland (degua- above 2300). About 53% of the region is lowland, 39% medium highland, 8% upper highland (BoFED, 2008).

Figure 1 location map of the study area



Source: Tigray Environmental Protection, Land Administration and Use Agency (TEPLAUA), 2013

The research site was in Raya Azebo wereda which is located in southern Tigray region of northern Ethiopia. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), Raya Azebo woreda has a total population of 135,870, an increase of 55.04% over the 1994 census, of whom 67,687 are men and 68,183 women; 16,056 or 11.82% are urban inhabitants. With an area of 2,132.83 square kilometers, Raya Azebo has a population density of 63.70, which is greater than the Zone average of 53.91 persons per square kilometer. A total of 32,360 households were counted in this woreda, resulting in an average of 4.20 persons to a household, and 31,468 housing units.

Raya azebo is characterized by kola agro-ecology with relatively hot temperature and high evaporation-transpiration that results in high level of moisture stress. As elsewhere in the rural highlands of Ethiopia, small scale mixed agriculture is the primary source of livelihood to the population.

3.2 Data Sources and Sampling Procedure

Both primary and secondary sources of information were collected for successful accomplishment of the study objectives. With regard to primary data the target of the study population are the small holder farm households of Tigrai region. Primary data were collected from sample households using structured questionnaire dispersing to different households and by leading face to face interview with different personality who is in charging of some responsibilities.

Checklist and structured questionnaire was used to collect the primary data. The questionnaire was pre-tested before the actual conduct of the interview using households identified for the Purpose. Experienced enumerators were recruited based on their proficiency in the local language and then trained on data collection techniques and on the content of the questionnaire.

A multistage sampling technique was used to determine the sample households. First, out of the two pilot woredas, we selected Raya azebo woreda purposely for the fact that majority of the households in the program are found in this woreda. Out of the total of 13,815 households having the modern certificates in the region 12,299 (89%) households are from this woreda. Raya azebo woreda is our particular interest because it was a place where the first modern certification was

started and officially launched in august 2011 and was appropriate to test the link between certificate tenure security, investment and productivity. Out of the total 18 tabias of Raya Azebo woreda, 8 tabias are under the program and the remaining 10 tabias (village) are not in the program. Further, 3 tabias from Raya azebo wereda which is in the program (treated) and another 3 tabias from non certified tabias was randomly selected. Third, parcel-based second level land holding certificate participant and non participant households were identified from the households list available at each tabias. Finally, representative samples were selected from six tabias based on probability proportional to sample size.

Systematic random sampling was used to select a specific household in each tabias. Following this procedure, 279 (116 household have parcel-based land holding certificates (treated) and 163 haven't certificates (control)) sample households were selected from both woredas. The treatment respondents are those who own land and received a certificate for that land under the program. The control group consists of landholders who may have been eligible to obtain a certificate but could not do so because the program was not carried out in their area. The control group was drawn from a neighboring area which, based on the assessment of the interviewers, has demographic, economic and land use characteristics similar to those of the treatment group. The purpose of the control group enables us to investigate the changes resulting from the program to be pinpointed.

3.3Method of Data Analysis

Concerning the methodology to be utilized this paper have been used both descriptive analysis and econometric models. In descriptive analysis data from rural household survey were analyzed through tables, means, standard deviation, percentages and frequencies to analysis the socio-economic characteristics of farmers input and output variables and plot level characteristics of the study area.

In the case econometrics analysis both parametric and non-parametric approaches was used to assess tenure security, investment and productivity impacts of landholding certificates. First, we compare non-parametrically tenure security perception, investment and land productivity on plots with and without land holding certificates. Here propensity score matching method was used to do this comparison. Propensity score matching was constructed on the base of observed household

and plot level characteristics and the common support requirement was imposed using appropriate matching estimator. Second, the researcher tried to assess impacts of parcel-based second level landholding certificates parametrically.

In case of the investment variable, the decisions whether to adopt soil conservation bound and stone terrace investment in plot, and how much to invest (intensity of investment), can be made jointly or separately. It can be argued that adoption and intensity of use decisions are not necessarily made jointly (Gebremedhin and Swinton, 2003). It is also possible to argue that the impacts of the second stage certificate on decision to invest and amount of investment may not be the same. In the case where the decision whether to adopt the land conservation investment and the decision about how much of it to adopt are not jointly made, it is more suitable to apply a "double-hurdle" model, in which a probit regression on adoption is followed by a truncated regression on the non-zero observations (Cragg, 1971).

Similar formulation as for the conservation investment models described above was used but the dependent variable "number of trees planted" is not strictly linear. It takes on the value of zero with a positive probability density at zero but is a continuous random variable over strictly positive values. For some households heads, an optimal choice is the corner solution of I =0. Therefore, the variable trees planted have a mixture of discrete and continuous distributions. The prior interest of this study was in the probability of a household planting tree given the ownership rights that he possesses Investment on tree. We therefore specified ***Tobit models.***

3.4 Econometric Frame Work and Estimation Strategy

Based on the conceptual framework summarized in Equation (1) (2) and (3) above and various related empirical works (bekele mekonen, 2012; Ghebru et al., 2008; Gebremedhin, 2002; Foltz et al., 2000 and Zikhali, 2008 and Deininger, 2009) general reduced form equations can be written as:

$$T = \gamma_0 + \gamma_1 C + \gamma_2 W + \gamma_3 X + v \qquad \textit{(4) Tenure security equation}$$

$$I = \beta_0 + \beta_1 C + \beta_2 W + \beta_3 X + u \qquad \text{(5) Investment equation}$$

$$Y = \theta_0 + \theta_1 C + \theta_2 W + \theta_3 X + \varepsilon \qquad \textit{(6) Farm productivity equation}$$

Where,γ's θ's and β's are parameters of be estimated while u, v and ε are error terms. We assume that the error terms are independently, identically and normally distributed with zero means (Wooldridge, 2002).

The strong argument that this study has pronounced is having second level land holding certificate is outside the decision of the household and household and parcel characteristics does not matter. Since the programmes are introduced in a few pilot (Raya azebo and Tahtay Adyabo) areas it is reasonable to use the eligible population from non-pilot area and propensity score modeling adequately captures area difference in participation and outcomes so that between area effects are controlled for. However, the decision to adopt tree planting and investment may be influenced by the gain from adoption. Estimation without controlling for this problem may lead to biased results. A Heckman self-selection correction approach is also tried to address this problem but the inverse Mills ratio was not significant. Thus, we report results only for probit and Tobit models since there is no problem of self-selection observed.

To deal with the challenge posed by the fact that beneficiaries of the certificate might not form a randomly selected sub-group of all farmers in the sample, this study were used the propensity score matching method to estimate the average treatment effect of the certificate on the intensity investments as well as on productivity. This study where retained the observations within common support from the matching process which will then used a double-hurdle model (to estimate equation 5) both IV-probit and probit model to estimate perceived tenure security and direct OLS and different specification of IV estimation (to estimate equation 6). Thus the analysis complements nonparametric methods with parametric methods and by using observations that lay within common support from the matching process we ensure that we have a comparable sample in estimating the parametric models. A detailed discussion of the estimation strategy follows below.

3.4.1 Propensity Score Matching

Experimental evaluation, in which assignment to treatment (for example participation in the modern certification) is random, has increasingly been encouraged and used in evaluating interventions because of its statistical advantages in identifying program impacts (Ravallion, 2000; Cameron and Trivedi, 2005). Although random assignment is an extraordinarily valuable tool for evaluation, it is not always feasible to implement it. Not only is it costly to obtain

cooperation of implementers of the intervention and study subjects, but a random assignment design must be developed and implemented prior to the start of the intervention (Becker and I chino, 2002).

This paper focuses on a specific nonexperimental evaluation method known as Propensity-score matching (PSM*).* PSM uses information from a pool of units that do not have second level certificate in the intervention to identify what would have happened to certify household's outcome (tenure security perception, decision to invest and amount of investment decision and level of productivity) in the absence of the certification. By comparing how outcomes differ for households having second level land holding certificates relative to observationally similar noncertified, it is possible to estimate the effects of the intervention.

*(A) Conditional Independence Assumption (CIA***)**

Conditional independence states that given a set of observable covariates *X* that are not affected by treatment; potential outcomes Y (where Y is the outcome indicator variables of tenure security, investment and land productivity) are independent of treatment assignment T. If ($Y_{1,}$ T) represents outcomes for participants and ($Y_{0,}$ C) outcomes for nonparticipants, Conditional independence implies:

$$(Y0, Y1) \perp T \mid X \qquad (7)$$

Matching households based on observed covariates might not be desirable or even feasible when the dimensions of the covariates are many. To overcome the curse of dimensionality, Rosenbaum and Rubin (1983) displayed that, for non-randomized observations, outcome and treatment are conditionally independent given the propensity score, P(x), which is the conditional probability of receiving treatment given pre-treatment characteristics:

$$(Y0, Y1) \perp T \mid P(x) \qquad (7a)$$

A balancing condition needs to be satisfied for propensity score matching. The balancing condition shows the conditional independence of participation in terms of control variables given the propensity score:

$$T \perp X \mid P(x) \qquad (7b)$$

Alternatively, the balancing condition indicates that for individuals with the same propensity score assignment to treatment is random. Thus, if the balancing condition is satisfied, observations having the same propensity score will have the same distribution of observable and unobservable characteristics irrespective of treatment. This implies that with the help of the propensity score, treatment is virtually randomized and, as a result, treatment and control group members will on average be observationally identical (Becker and I chino, 2002).

(B) Assumption of Common Support

A second assumption is the common support or overlap condition: $0 < P\ (T_i = 1|X_i) < 1$. This condition ensures that treatment observations have comparison observations "nearby" in the propensity score distribution (Heckman, LaLonde, and Smith 1999). Specifically, the effectiveness of PSM also depends on having a large and roughly equal number of participant and nonparticipant observations so that a substantial region of common support can be found. For estimating the ATT, this assumption can be relaxed to $P\ (T_i = 1|X_i) < 1$.

Treatment units will therefore have to be similar to non treatment units in terms of observed characteristics unaffected by participation; thus, some non treatment units may have to be dropped to ensure comparability. However, sometimes a nonrandom subset of the treatment sample may have to be dropped if similar comparison units do not exist (Ravallion 2008).

Once the propensity score is known and the balancing assumption is met, impact of the program or ATT can be estimated on the continuous outcome variables. Estimating the propensity score involves decision on two choices; what model to be used for the estimation and what variables should be included in this model. Due to the complexity of estimation procedure of probit model than the logit model, logit is widely used (Caliendo and Kopeinig, 2008). To capture this advantage, the *logit model* will be uses for estimating the propensity score in this study.

According to Gujarati (2004), in estimating the logit model, the dependent variable is participation (the household is from the certified village in this case) which takes a value of 1 if the household participated in a program and 0 otherwise. The logit model is mathematically formulated as follows:

$$P_i = \frac{e^{Z_i}}{1+e^{Z_i}} \qquad (8)$$

Where, P_i is the probability of participating in the parcel-based second level land holding certificate program, $Z_i = \beta 0 + \sum \beta_i X_i$ (8a)

Where

, i= 1, 2, 3, - --, n

β_0= intercept and β_1=regression coefficients to be estimated

X_i=pre intervention characteristic

The probability that a household belongs to the non participant group is:

$$Pi = \frac{1}{1+e^{Z_i}} \quad (8b)$$

Finally, by taking the natural log of the above equation the log of odds ratio can be written as:

$$L_i = ln\left(\frac{P_i}{1-P_i}\right) = Ln\left(e^{+\sum_{j=1}^{n}\beta_i X_i}\right) = Z_i = \beta 0 + \sum_{j=1}^{n}\beta_i X_i \qquad (8c)$$

Where, L_i is log of the odds ratio in favour of participation in the program which is not only linear in X_{ji} but also linear in the parameters according to matching theory (Rosenbaum and Robin, 1983; Bryson *et al*., 2002; Jalan and Ravallion, 2003)

In relation to which variable to include the important point is selecting which variables to include in the model and/or which to collect data on. Heckman et al., (1997) show that omitting important variables can seriously increase bias in the resulting estimates. In fact, only those variables that influence both participation and outcome should be included. It is not always clear what these variables should be, however, careful judgment is required. Ideally, economic and social theory should provide some guidance in determining important variables. The effect of household's participation in the certificate on a given outcome (Y) is specified as:

$$Z_i = Y_i(T_i = 1) - Y_i(T_i = 0) \qquad (9)$$

Where Z_i is treatment effect (effect due to certificates), Y_i is the outcome indicator (tenure security, decision to invest and level of investment and productivity level) on household *i*, T_i is whether household *i* have certificate for his plot or not. Nonetheless, since Y_i (T_i=1) and Y_i (T_i = 0) cannot be observed for the same household simultaneously, estimating individual treatment effect T_i is impossible and one has to shift to estimating the average treatment effects of the

population than the individual one. The most commonly used average treatment effect estimation is the 'average treatment effect on the treated (ATT) which is specified as:

$$ATT = E(Y1i - Y0i \mid Ti = 1) \quad (9a)$$

$$= E[Y1i \mid Ti = 1] - E[Y0i \mid Ti = 1] \quad (9b)$$

Since the counterfactual mean for those being treated, $E[Y0i \mid Ti = 1]$ is not observed, there is a need to choose a proper substitute for it to estimate ATT. Though it might be thought that using the mean outcome of the untreated individuals, $E[Y_{0i} \mid T_i = 0]$ as a substitute to the counterfactual. Using the propensity score to deal with selection bias, equation above is thus modified as follows as stated in Becker and I chino, (2000)

$$ATT = E(E(Y1i - Y0i \mid Ti = 1, P(Xi))) \quad (9c)$$

$$= E[E(Y1i \mid Ti = 1, P(Xi)) - E(Y0i \mid Ti = 0, P(Xi)) \mid Ti = 1] \quad (9d)$$

The sample equivalence is given by:

$$ATT = {}^{1}/_{n} \sum_{i=1}^{n} [(Y_{1i} \mid T_i = 1, P(X_i)) - (Y_{0i} \mid T_i = 0, P(X_i)) \mid T_i = 1] \quad (9e)$$

Estimation of ATT using PSM involves three basic steps: computing the propensity score, matching on the basis of propensity score, and obtaining the treatment effect as a difference of the mean outcomes of participants and non-participants from the matched observations if necessary. For the consistence and robustness of results, the study will try to apply four different methods of matching. (*Nearest Neighbor (NN), Radius matching (RM), Stratification and interval matching(SM) and Kernel matching (KM))*

3.4.2 Land Tenure Security Impact Model

Perceived tenure security is defined as the degree of confidence held by people over their land claim or land right (Dekker 2003; Kanji, Cotula et al. 2005; Gelder, 2009). The determinants for perceived security are fear for eviction (land taking), possibilities of cultivating the same field after five year (certainty) in this case. Fear of eviction is the strongest determinant for perceived security. Certainty indicates that the perception of the owner of the plot to cultivate the same field after five years. To estimate the program impacts on perceived tenure security equation (4), this research tries to use *two* main tenure security indicators (representatives) T_i. The first one is household perception level about the plot that he have, whether the household i has a confidence (feel certain) to cultivate the same field after 5 years (1=if certain; 0=not). Lead us to adopt a ***probit*** specification.

$$T_i = \gamma_0 + \gamma_1 C + \gamma_2 X + \gamma_3 W + v \qquad (10)$$

Where T is tenure security indicator of household i and C is the dummy variable of interest 1 if the household have parcel based second level land holding certificates, 0 otherwise (alternative certificate variable (the predicted certificate derived from linear probability model or the actual certificate values) will be used as robust estimator). X and W is vector of household and plot level characteristics respectively.

Another indicator about tenure security is the fear of eviction (land taking). This indicates whether the household fear for land grab due to any administration intervention either to redistribute the land equally to the new generation or to the peoples who can use this plot more efficiently. This is common in Raya Azebo woreda due to it is high investment potential area and land is fixed asset and peoples need for that are increasing from time to time. We used the same specification like the certainty model described above.

3.4.3 Investment Impact Model

For the agricultural investment variable, respondents were asked whether they had made any major capital investments in their land and the amount of investment (intensity) if any in the last two years. Two different possible types of invest was reported. One with little tenure-security but large productivity impacts (henceforth labeled as soil conservation and terracing) and one with high tenure security but limited productivity impact (tree planting). Furthermore, the dependent variables used in the study are classified as adoption decision and intensity of adoption (how much) of soil conservation practices and stone terracing. Intensity of use is measured as the number of meters per tsimdi of terraces or soil bunds constructed.

3.4.3.1 Soil and Water Conservation and Stone Terrace Investment Models

Information on whether such investment was undertaken (decision to invest) and how much to invest (intensity) investment was elicited directly from respondents. It can be argued that such type of decision are not necessarily made jointly(Gebremedhin and Swinton, 2003).The decision to adopt may precede the decision on the intensity of use and, the impacts of certificate for each decision may be different, as assumed in the present case. This lead the researcher to adopt 'double hurdle' model in which, the dependent variable for the first hurdle of soil conservation investment take the value of 1 if the plot receives any type of soil or water conservation

investment (bound) or if household spent some amount of hours working on such investment during the past 18 months 0 other wise, leading us to adopt a probit specification.

For plots receives any type of soil and water conservation, the respondent were asked how much was invested (m/tsimdi) in the last 18 months leading as to adopt truncated regression model in the second hurdle. The same specification was used for the decision and intensity of stone terrace. Alternative models with the actual and predicted certificate variables or instrumental variable probit specification were run to compare the results.

To understand the impact of parcel based second level landholding certificate in both probability of adoption and intensity of adoption, it was necessary to go beyond the typical binary dependent variable methods applied to cross-sectional surveys on technology adoption (Feder et al., 1992).

3.4.2.2 Tree Planting Investment Models

Deininger and Jin (2006) show that in Ethiopia, households that had just experienced land redistribution were more likely to invest in tree planting (a security enhancement measure) than soil bound and terracing (productivity enhancement); however, households that expressed an expectation of future redistribution showed lower investment. We used a similar formulation as for the conservation investment models described above but the dependent variable "number of trees planted" is not strictly linear. It takes on the value of zero with a positive probability density at zero but is a continuous random variable over strictly positive values. For some households heads, an optimal choice is the corner solution of I =0. Therefore, the variable trees planted have a mixture of discrete and continuous distributions. This study is interested in the probability of a man planting trees given the ownership rights that he possesses Investment on tree. This leads the researcher to specified Tobit models for the number of trees planting on the plots. Also in this case will be uses data from household and plot level characteristics similarly as for the conservation investment models used above.

3.4.2.3 The Double Hurdle Model and Variants

a) The Tobit Model

First, consider the linear specification as modeled in Moffatt (2003):

$$I_i^* = \mu C + X'_i\beta + u_i \qquad (11)$$

$$u_i \sim N(0, \sigma^2) \qquad (11a)$$

Where I_i^* is latent variable representing household *i's* propensity to invest, X_i is a vector of household, plot and community characteristics relevant in explaining the intensity(extent) of investment β is a corresponding vector of parameters to be estimated, and u_i is a homoscedastic, normally distributed error term. Let I_i be the actual investment (e.g. length in meters). Since actual investment cannot be negative, the relationship between I_i* and I_i is:

$$I_i = max\ (I_i^*, 0) \qquad (11b)$$

This equation gives rise to the standard censored regression ("tobit") model estimation of which is routinely available in econometric software package STATA. The log-likelihood function for the Tobit model is:

$$LogL = \sum_0 ln\left[1 - \Phi\left(\frac{X'_i\beta}{\sigma}\right)\right] + \sum_+ ln\left[\frac{1}{\sigma}\phi\left(\frac{I_i - X'_i\beta}{\sigma}\right)\right] \qquad (11c)$$

In which "0" indicates summation over the zero observations in the sample, while "+" indicates summation over positive observations. Φ (.) and ϕ (.) are the standard normal *cdf* and *pdf* respectively.

However the Tobit models have potential shortcomings due to the restrictive assumptions it makes (Blundell and Meghir, 1987). In particular, it assumes that all zero observations are, in fact, standard corner solutions and those households who do not adopt do so as a result of their economic circumstances. However, it is possible that some farm households would never state a positive amount as a matter of principle (It may be that they do not believe that taking care of the land is their responsibility, which is possible in Ethiopia where land is not privately owned, or it may be that they do not adopt because of their belief that, their adoption will unlikely make any real difference) or because they consider soil conservation investment or adoption of stone terrace as a bad Mekonnen et al., (2012). This is encouragement to this study to use the parametric generalized double hurdle model.

B) The Double Hurdle Model

The decisions on whether to adopt and how much to adopt can be made jointly or separately. When the decisions are made jointly, the Tobit model is appropriate for analyzing the factors affecting the joint decision (Greene, 2000). This assumption has been the norm in previous research into the determinants of the intensity of soil conservation investments (Sureshwaran et al., 1996; Pender and Kerr, 1998). However, adoption and intensity of use decisions are not necessarily made jointly. The decision to adopt may precede the decision on the intensity of use, the impact of certificate on decision to invest and how much to invest may be different (Gebremehin et al, 2003). In this case, it is more suitable to apply a 'double hurdle' model in which a probit regression on adoption (using all observations) is followed by a truncated regression on the non-zero observations (Cragg, 1971).

The double hurdle model is designed to analyze instances of an event which may or may not take place and if it takes place, takes on continuous positive values. In the case impact of certificate on adoption of soil conservation practices (e.g. building terraces or bunds) and impacts of certificate on the intensity of use (how many meters per hectare of terracing or bunds) conditioning decision to adopt follows.

In the double-hurdle model, both hurdles have equations associated with them, incorporating the effects of adopter characteristics and circumstances. An explanatory variable may appear in both equations or in either of them, and a variable appearing in both equations may have opposite effects in the two equations. The double-hurdle model contains two equations the adoption equation and the equation on the level of adoption (Moffatt, 2005)

$$d_i^{*} = \delta C + Z_i'\alpha + \xi_i \qquad (13)$$

$$I_i^{**} = \mu C + X'_i\beta + u_i \qquad (14)$$

$$\begin{pmatrix}\xi_i \\ u_i\end{pmatrix} \sim N\left[\begin{pmatrix}0\\0\end{pmatrix}\begin{pmatrix}1 & 0\\ 0 & \sigma^2\end{pmatrix}\right] \qquad (15)$$

Where d_i^{*} is a latent adoption variable that takes the value 1 if the household adopted land conservation investment, and 0 otherwise; Z is a vector of explanatory variables; and α is a vector of parameters. I represent intensity of adoption and X is a vector of explanatory variables, and β is a vector of parameters. C is policy variable of interest (1 if the household have parcel based certificate for his plot, 0 otherwise). δ and μ are parameter of interest show impacts of the parcel

based second level land holding certificate on decision to invest and how much to invest (intensity) respectively.

The first hurdle is then represented by:

$$d_i = 1 \quad if \quad d_i^* > 0 \qquad (13a)$$

$$d_i = 0 \quad if \quad d_i^* \leq 0 \qquad (13b)$$

The second hurdle is designated as $I_i^* = \max(I_i^{**}, 0)$ (14a)

The observed variable I_i is finally determined *by* $I_i = d_i I_i^*$ *(14b)*

The log likely hood function for double hurdle model is:

$$LogL = \sum_0 ln\left[1 - \Phi(Z_i'\alpha)\ \Phi\left(\frac{X'_i\beta}{\sigma}\right)\right] + \sum_+ ln\left[\Phi(Z'_i\alpha)\frac{1}{\sigma}\phi\left(\frac{I_i - X'_i\beta}{\sigma}\right)\right] \qquad (15)$$

The double hurdle model (as originally proposed by Cragg 1971) is equivalent to a combination of truncated regression model and univariate probit model provided the assumption of independent between the error terms. Following Cragg (1971), the decision on adoption can be modeled as a probit regression (Gebremedhin and Swinton, 2003; Bekele and Mekonnen, 2012)

$$F(I = 1/X1, X2) = C(X'_1, \beta) \qquad (16)$$

Where C (.) is normal cumulative distribution function and X1, X2 are vectors of explanatory variables, not necessarily distinct. The decision on the intensity of use can be modeled as a regression truncated as zero:

$$f(I/X1, X2) = (\pi)^{-\frac{1}{2}}\sigma^{-1}\ exp\left\{\frac{-(I - X_2'\gamma)^2}{2\sigma^2}\right\} X\ \frac{C(X'_1\beta)}{C(X'_2\gamma/\sigma)}\ \ for\ I > 0 \qquad (17)$$

3.4.2.4 Test for Model Appropriateness

Whether a Tobit or a double hurdle model is more appropriate can be determined by separately running the Tobit and the double hurdle models and then conducting a likelihood ratio test that compares the Tobit with the sum of the log likelihood functions of the probit and truncated regression models or the double hurdle model (Greene, 2000).

3.4.3 Productivity Impact Models

In addition to exploring the impact of certification on tenure security and investment, the researcher wants to assess the productivity impacts of certification and thus the broader economic

relevance of these issues. To do so we cannot be sure that land quality and basic household characteristics are the same for plots with and without certificate (Ghebru et al, 2008). A two- step approach was used to deal with this problem: (a) using nonparametric matching on observable plot characteristics to identify a sample that satisfies common support and estimated the impacts of the certificate on productivity and (b) using parametric regressions on the sample of plots that satisfies the common support requirement (Ho et al. 2007, Ghebru H. et al, 2008).

The matched data of plots that were used in the productivity analysis included the plots planted with cereal crops with and with-out certificates that satisfies the common support requirement but excluding rented-in plots. The propensity score is contracted based on observable plot characteristics without including the endogenous investment variables through which the land certification may have affected productivity. Then it is possible to imposes the common support requirement using appropriate matching methods (Becker and Ichino 2002; Dehejia and Wahba 2002). This kind of data preprocessing reduces model dependence in the following parametric analysis (Ho et al. 2007).

First, by using the propensity score matching approach and compare productivity per tsimdi on plots with and with-out certificates for the plots that met the common support requirements. Then it is possible to assess the impacts on land productivity of land certification directly and through the investment I* variables that possibly were affected by certification. I is dummy variable of investment type (productivity enhancing investments such as soil conservation and stone terrace or security enhance investment such as tree planting). However, the study practically first estimate the reduced form of the investment function that is, Equation (5). It then uses the generated residuals as explanatory variables in the second-stage equation, which is the equation explaining land productivity that is, Equation (18). This is done to test for the exogeneity of investment variable in Equation (18).

$$Y = \theta_0 + \theta_1 C + \theta_2 I^* + \theta_3 W + ku + \varepsilon \qquad (18)$$

The procedure establishes whether there is simultaneity bias using the criterion of a test of the significance of k, the coefficient of u (investment residual). If k does not significantly differ from zero, then there is no simultaneity bias and vice versa.

Two alternative specifications for the dependent variable will be use; total value of output per tsimdi, and log of total value of output per tsimdi.

3.5 Description of Variables Used in the Analysis

The selection of explanatory variables that this studies is used is based on various related empirical works such as (Gebremedhin and Swinton, 2003; Ghebru et al., 2008; Hagos and Holden, 2006; Kabubo-Mariara, 2007; Brasselle et al., 2002; Deininger et al., 2007; Holden and Yohannes, 2002; Bekele and Mekonnen, 2012). In view of this the impacts of this program on tenure security, investment and productivity of the parametric estimation is viewed as a function of vector of eight groups of variables (Socio –institutional factors, social capital variables, input, physical factors or plot level characteristics, house hold demographic characteristics, market access variables, Interaction variables and site dummy)

I. Impact indicator: - the impact indicator used in this study are:-

Tenure security indicator: - this study tries to be use of two main tenure security indicators (representatives) T_i. The first one is household perception level about the plot that he have, whether the household has a confidence (feel certain) to cultivate the same field after 5 years (1=if certain; 0=not). Another indicator about tenure security is the fear of eviction (land taking) 1= if fear for land taking, 0 otherwise. Lead us to adopt a ***probit*** specification

Farm level investment: - For the agricultural investment variable, respondents will be asking whether they had made any major capital investments in their land and the amount of investment (intensity) if any in the last two years. Two different possible types of investments are expected to be reported. One with little tenure-security but large productivity impacts (henceforth labeled as soil conservation and terracing) and one with high tenure security but limited productivity impact ("tree planting"). Furthermore, the dependent variables used in the study are classified as adoption (invest or not invest) and intensity of investment (how much) of soil conservation practices and stone terrace constructed. Intensity of use measured as the number of meters per tsimdi (m/tsimdi) of terraces or bounds constructed.

Land productivity: - the impacts on land productivity of land certification directly and through the investment variables that possibly affect by certification. The log of value of all crop's produced in his own plot is used as dependent variable.

II. Treatment variable: the treatment variable used in this study is whether household have the modern parcel-based second level land holding certificate for his plot. it is binary response(1= if the household is from the certified village, 0 other wise)

III. Independent variables: in this regard, the researcher reviewed carefully various literatures and theoretical backing to identify variables to be used to estimate the propensity score matching and to estimate the impacts of the program using parametric approach. To ensure that variables are not affected by participation in the program, they should either be fixed over time or measured before participation Rosenbaum and Rubin (1983). These variables are believed to be time invariant control variables and are commonly used in, most impact literature. To minimize contamination with participation, variables that is before such as livestock holding, number of oxen owned and land holding size are used in the model.

House hold demographic characteristics

Age of the household head and Age square: - is one of the explanatory variables that are supposed to have an impact on out came variable. The effect of age of farmer on investment and productivity was anticipated to be either positive or negative but affects tenure security negatively; as age increases there is an experience effect which is productivity and investment increasing (potentially).

On the other hand, as the farmers get older his managerial ability and physical capability are expected to decrease. Old aged farmers are also less receptive to new inputs and technologies, implying negative relationship between age and, investment and productivity. Older households to be more likely to invest in productivity enhance factors (soil conservation) than securities enhance factors if they are deciding to invest. In addition, older household heads where more likely to expect land loss (more insecure) this is due to administration measure may redistributed productive assets among the generation. To capture these different effects, both age and age square will be considered in the analysis. The empirical study made by Deininger et al. (2009) supports this argument.

Gender or sex of the house hold head: - is considered as one variable of the regression and it is entered as dummy variable in which 1 is assigned for male head household and 0 for female headed households. It is expected that male-headed households perform better than their counter part in investment and productivity since they are more able to mobilize labor and other factors of production for their plots within the family and women's are most of the time do not carry on plowing by them. The practice is either they rent out their land for sharecropper or look for somebody/relative who does the plowing operation, which affects timely operation and/ or size of harvest and my not decide to invest to improve the plot as much to his own plot. The empirical studies made by Udry (1995), Goldstein and Udry (2005), and Holden et al. (2001) of gender specific issue related with this support this argument.

On the other hand, women household might be worried about future land distribution and they are less secure than male headed households and then, would be more likely to engage in security enhancing factors such as tree planting because they initially were more tenure insecure and land certificates increased their tenure security relatively more.

Literacy of household: - this is a discrete variable takes a value of 1 for literate households, which include both that can read write and those who achieved formal school. A value of 0 is assigned for illiterate households. Literacy of household members is hypothesized to have positive effect on decision and intensity of investment and better awareness and then more productive.

Dependency ratio: - is the ratio of working-age to total household members of the household members. The higher the number of children a household has, the lower the perceived tenure security. Having a lot of dependants is demanding in terms of labor hours spent taking care of them and this obviously implies less time spent monitoring parcels which expects lower level of investment and productivity. Therefore, it is hypothesized that this variable has positive effect on both out came variable negatively and significantly.

Number of adult male and number of adult females: - is a continuous variable measured in number of family members of age [15-64] years. In principle, adults(labor force) is a key input in agriculture in general and decision to invest and amount of investment that led to enhance both productivity and tenure security in particular. Therefore, number of male/female adults of the

household head is hypothesized to positively affect tenure security, both types of investment and productivity.

Livestock ownership in Tropical livestock unit (wealth):- is a continuous variable of number of livestock measured in TLU owned by each household. The variable is labeled TLU, and considered as wealth indictor. This variable measures the number of livestock owned weighted by the tropical livestock unit transformation standard. Theoretically, livestock can support investment and productivity in two ways. First, livestock is sign of wealth it helps to purchase inputs such as fertilizer and to hired labor to improve the plot interims of investment. Second, they provide farmyard manure and compost for fertilizer and this lead to improve productivity of the plot. In this regard, livestock ownership has positive impact on investment on land and productivity. On the other hands, more specialization into livestock away from cropping may reduce focuses given to crop production and investment in plot which leads to negative relationship between livestock and physical sustainable land management practices. Most empirical results ensure this inverse relationship (Holden and Hailu, 2002; Aklilu, 2006; Abebaw et al., 2011) while some research results, for example (Fikru, 2009) shows a positive relationship between livestock and physical investment. Therefore, livestock ownership has a positive relationship with productivity and indecisive sign on soil bund construction and stone terrace.

Number of oxen owned (oxen):- is a continuous variable measure in number. Most often, farmers who have one ox plow their fields by joining hands with others / peer. It could be envisaged that lack of adequate draught power leads to delay and poor land preparation, inefficient farm operations and late planting with a major depressing effect on yield. Therefore, number of oxen owned was hypothesized to have positive effect on productivity.

Plot level characteristics

Plot size: - is a continuous variable measured in tsimdi (traditional method of measuring size of land) and aggregating the size of different plots that the household has. The effect of land size in investment is ambiguous. On the one hand, more land indicates greater wealth and capacity and should encourage investment on the other; more land may reduce the need to conserve land. A higher per-capita land endowment, relative to the village median lead to increase the perceived likelihood of land loss and reduce the expectation of gain, as that aims to distributed a limited amount of communal land as equitable among rural residents.

Distance of plots from homestead: - is a continuous variable measured in a minute of walk from homesteads. Near plots get supervision and attention from family (Berhanu and Swinton, 2003; Wogayehu and Drake, 2003). It also raises time and the cost of carrying manure from the homestead. In light of this, it is hypothesized to have negative effects of distance of plots from home stead to all types of investment and productivity.

Slope of plots: - steepness of a plot initiates farmers to invest in soil and water conservation and stone terrace practices to protect their plots. Hence, there is a positive relationship between steepness of plots and in soil bund construction. Empirical evidences ensure this fact (Pender and Kerr, 1998; Aklilu 2006). Therefore, it is hypothesized to positively influence investment and productivity.

Soil depth: - When soil depth is deep, farmers have little incentive to prevent soil loss and are unwilling to adopt conservation technologies, as there is little benefit from soil conservation. The empirical studies by (Pender and Kerr, 1998; Mbaga-Semgalawe and Folmer, 2000; Shively, 2001) support this argument.

Fertility status of plots: - plots with fertile soils that are expected to give high return will have higher marginal productivity loss. In this regard, soil fertility status has positive relationship with investment in land practices (Berhanu and Swinton, 2003; Wogayehu and Drake, 2003). On the other hand, soil and water conservation covers fertile areas of a plot reducing cultivable areas which makes farmers reluctant to use SWC practices (Aklilu, 2006). Fertile soils are more productive than its counterpart. Therefore, it is hypothesized that soil fertility status has undecided effect on soil bund construction and positive relation with productivity.

Input

Modern Fertilizer use: - in this case value for fertilizer is considered to make the labialization of fertilizers comparable across household. To obtain this, the quantity of fertilizer used by the households is multiplied by the price of the fertilizer. In this case, DAP and UREA is the fertilizers used. It is hypothesized that amount of fertilizer used enhance productivity positively and significantly.

Manure: - is a dummy variable takes value a value of 1 if a household participated in manure traditional or compost and it is expected to positively associate with productivity.

Improved seed use: - in this case value for seed is considered to make the labialization of improved seed comparable across household. To obtain this, the quantity of improved seed used by the households is multiplied by the price of the fertilizer. In and It is hypothesized that amount of fertilizer used enhance productivity positively and significantly.

Endowment of soil and water conservation bound or stone terrace: - it is treated as a continuous variables, length of soil bound constricted or stone terrace constructed before the program is started. This past investment can affect current investment through the knowledge (learning from experience) bout the advantage of such investment. It have also negative effect due to land size is limited and such investment may already invest in the past and have such investment in the plot. So this study has ambiguous sign on investment. But it is clear that productivity is high on plots with such types of investment.

Endowment of tree planted: - it is continuous variable of number of young tree planted before the program is lunched. It may have positive effect on tenure security. Plots with large number of tree may have confidence to cultivate this land next future and never fear for land grab. This encourages farmers to invest more of soil bound and stone terrace and have better productivity also.

Off –farm activity and social capital

Off farm participation:-it is treated as a dummy variable which is measured as 1 if the household is involved in off/non-farm activities, 0 otherwise. A study conducted in Ethiopia reveals that today access to supplementary non-farm source of income is a necessity rather than a luxury, because the core economic sources (farming and livestock) are not able to sustain the peasants on a stable basis (Desale,2008). Farm households carrying out these income generating activities always look for new income generating activities. This may lead to reduce concentration given to investment on land and improvement of land quality and reduce productivity. On the other extreme, the rural non-farm sector might contribute to improved farm productivity of peasant households, through its income effect, by relaxing their capital or liquidity constraint and allowing the purchase of inputs such as farm labor, seeds, fertilizer and pesticides (Woldehanna, 2000). On the balance, the net effect of involvement in non-farm activities was hypothesized to be either positive or negative, depending on the relative magnitude of the two effects.

Remittances: - any national or international remittance expected to have positive effect on both decision to invest and how much to invest and productivity through the income effect.

Socio-institutional factors

Household head Perception pressure from community to conserve soil: - it is treated as a dummy variable which is measured as 1 if the household is involved in off/non-farm activities, 0 otherwise. This increase both types of investment and have better productivity. Studies conducted by Gebremedhin et al., 2003 also support this argument.

Public investment: - is a dummy variable take a value of 1, if one of household plots receives any soil or stone terrace investment. Public investment variable should both control for its direct impact at plot level investment and its indirect crowding-in and crowding-out effects on private investment. Due to the substitution effect, public soil conservation campaign beneficiaries were expected to invest less in private investment and give less concentration to privet land.

Development agents visit frequency: - is continuous variable measured in number of days own field visited by DA or household receive training related with and household visit to model farmers to take experience. Visit of development agent (access to extension services) has a positive influence on investment and land productivity because farmers who have access to extension services get training that enhance their knowledge. Studies show that access to extension services has a positive effect both on fertilizer use (Chilot, 2007; Maiangwa et al., 2007) and on soil bund construction (Abebaw et al., 2011). Hence, it is hypothesized to have a positive sign on investment on land and land productivity in this study.

Membership to farming cooperatives: - It is a dummy variable which takes value 1 if the farmer is member to farmer's cooperative, 0 otherwise. These farmers are more likely to get information related to farming activities over their counterparts and get farming equipments and modern input with reasonable price and around their home stated (Jean-Luc, 2006, Lakew, 1998). Hence, it is hypothesized that this variable raises both types of investment and productivity.

Interaction variable: - We also include an interaction of a dummy that captures whether the household believes investing on land enhances tenure security with investment levels to

investigate whether believing investing on land enhances security and actually undertaking investments affects perceived tenure security.

Site Dummy: - sustainable land management practices depend on the topography of area in consideration. In areas with steep slope, SWC practices such as soil and stone bunds are common than areas with flat features. The application of natural fertilizer also depends on the availability of livestock that provide manure.

Table3.1 description of variables used to estimate PSM using logit model

Dependent variable: household receive second level landholding certificates to his plot

Variable Name	***Description***
sexhh	Sex of the household head, 1= male, 0= female
agehh	Age of household head
educhh	education
adulthh	Number of adult for the household
own_land	Own farm size in "Tsimdi"[5]
plotdist	Average distance from plot to homestead
plot_age	Plot age
first_certi	Dummy of household have first stage
bak_type	Soil type: Ba'ekel
walk_type	Soil type: Walka
hut_type	Soil type: Hutsa
mek_type	Soil type: Mekeyih
slop1	Slope: Flat slope
slop2	Slope: Moderate slope
slop3	Slope: steep slope
sd_shallow	Soil depth: Shallow
sd_medium	Soil depth: Medium
sd_deep	soil depth: Deep
oxen_2003	Number of oxen for the household before
tlu_2003	Tropical livestock unit for the household
youngtree	Number of young trees in the plot
SWC_2003	length of soil bound before participation
STC_2003	stone terrace constructed before certification

Source: own survey, 2013

[5] One tsimdi equivalent to 0.25 hectare

CHAPTER- FOUR

4. RESULTS AND DISCUSSIONS

This chapter presents the main results and discussions of the study. Before we proceed to the detail analysis part, it is very indispensable to define and describe basic variables which are used for the analysis. To give a good picture about the program participants and non participants basic household and plot characteristics are presented in detailed based on their treatment categories. Next, the study presents and discusses the impacts of parcel based second level land holding certificates on tenure security, investment and land productivity of the matched respondents using the selected economic estimators.

Our construction of the certification variable follows Deininger et al. (2009). The choice to construct the certification treatment variable at a village level as opposed to household or plot level is based on the fact that the program was implemented for 8 of the 18 villages in or before the year 2011/2. Defining certification at the household level would require that households within certified villages that did not receive certification were unaffected by the certification process. However, as the majority of households received certificates in the certified villages, there are likely to be spill-over effects. In addition, the households that did not receive certificates (we get 4 households who have the certificate but not in their hands because of random administration failures) were mainly excluded for exogenous reasons. Hence, households coded as non-certified in certified villages are mainly constituted by households waiting for their certificate. Treating these households as non-treated would contribute to bias due to measurement errors.

4.1 Descriptive statistics

4.1.1 Summary of variables used in the analysis

Basic variables name description used in the analysis are provided in annex 1. To illustrate the evaluation of key dependent variables annex 2 shows details of summary statistics for key variables used in the analysis based on treatment category for 116 and 163 households in treated and control villages respectively. While there is a bit difference in the household characteristics,

systematic differences at the household level encourage to the importance of controlling for household heterogeneity.

As can be seen from the Table 4.1 below 80 percent of the survey households are male headed and the remaining 20 percent are female headed. Similarly, Table 4.1 also indicated that 82 percent and 77 percent of the non-certified and certified respondents are male headed respectively. Average age of full sample, Non-certified and certified households is 47.8, 46.8 and 49 respectively. Non-certified households are better performing in education (22 percent are literate) as compare to certified households with only 20.7 percent literate. Literate in this case comprises of two categories, which includes both that can read and write as well as those who have achieved higher level of education (formal) such as being enrolled in primary and secondary schools.

In terms of number of adult, the non-certified households have equivalent to 1.59 male and 1.54 female adults (whose age are between 14 and 65) where as the certified respondents have equivalent to 1.5 male and 1.66 female adults. This shows that certified respondents have more female adult members where as Non-certified respondents have more male adults but both are not statistically significant.

Table4.1Summary statistics for key household variables by treatment category

Certificate	***Sexhh***	***Agehh***	***Educhh***	***Adumale***	***Adufem***	***Own_land***	***Oxen***	***tlu***
Non certified	.822	46.798	.221	1.588	1.540	5.503	1.564	4.922
Certified	.775	49.293	.208	1.491	1.655	5.112	1.069	4.562
Diff.	0.046	-2.495	0.139	0.976	-0.115	0.390	0.495***	0.360
t-test	0.954	-1.520	0.278	0.764	-0.967	1.120	3.466	0.358
Full sample	.803	47.835	.215	1.548	1.588	5.340	1.358	4.773

Source: Own survey data, 2013

With regard to asset holding, the size of own land cultivated by non-certified respondents is little bit larger than that of the certified one cloth to 0.4 Tsimdi. Oxen holding, this is the only significant variable which is systematically different among certified and non-certified households. Certified households have cloth to 0.5 units of oxen lower than their counter part and it is statistically significant at 1 percent level of significance. Regarding to indicators of wealth, such as the amount of livestock holding, certified respondents have around 4.56 tropical livestock unit where as non-certified respondents have 4.92 tropical livestock unit.

Attributes for the 229 and 289 plots in treated and control villages respectively; except in oxen holding there is no statistically significant difference among certified and non-certified households. Average numbers of parcels for certified and non-certified are 1.78 and 1.72, respectively. Similarly, the average distance of plot from homesteaded is 2.07 and 1.81 kilometers for control and treated households. The registered plot and non registered plots had been in possesses of current owner for similarly around 18 years.

Table4.2Plot level characteristics by treatment category.

Variable name	**Non-certified**	**With Certificate**	***Differences***	***T-test***
Number of parcel	1.72	1.78	-0.060	-0.805
Average distance of plot (km)	2.07	1.81	0.264	1.418
Number of years plot possessed	17	18.33	-1.403	-1.476
Soil type: Bake'akl	.09	.08	0.008	0.247
Soil type: Walka	.71	.65	0.0651	1.176
Soil type: Hutsa	.18	.18	0.003	0.064
Soil type: Mekayh	.26	.26	0.005	0.097
Plot slope: Flat	.89	.91	-0.024	-0.662
Plot slope: Moderate	.07	..03	0.027	1.011
Plot slope: Steep	.13	.13	0.006	0.137
Soil depth: Shallow	.44	.41	0.060	0.606
Soil depth: Medium	.33	.33	0.004	0.064
Soil depth: Deep	.53	.5	0.042	0.696

Source: Own survey data, 2013

As far as plot characteristics are concerned, Table 4.2 describes details about soil type, slope and soil depth used as proxy variable for soil quality. Majority of the registered plots (65 percents) are *Walka* soil type followed by *mekayh* (26 percent), *Husta* (18 percent) and *Ba'ekel* 89 and 91 percents of the register and non registered plots are Flat slope. There is a far distribution of plots among different soil depth in both the treated villages and control villages.

4.1.2 Overview of the Program Implementation in the Study Area

The government of Ethiopia together with development partners has been undertaking field testing exercises to improve and update the previous land certification program. Tigray Environmental Protection, Land Administration and Use Agency (TEPLAUA) have been implementing Ethiopia Strengthening Land Administration Program (ELAP) with financial support of USAID and technical assistance of TETRA TECH ARD in Raya Azebo and Tahtay Adyabo wereda of Tigray Regional State since January 2009. The parcel-based second level

landholding certificate was officially launched in Tigray in July, 2011 even if some households are receiving certificate before. Community-level data shows that the process was implemented in two woredas of Tigrai and total of 13,815 households (12,299 from Raya Azebo and the remaining 1516 households from Tahtay Adyabo) and 25,690 parcels receives certificate. Details of the registration program of the selected kebeles are presented in the following Table.

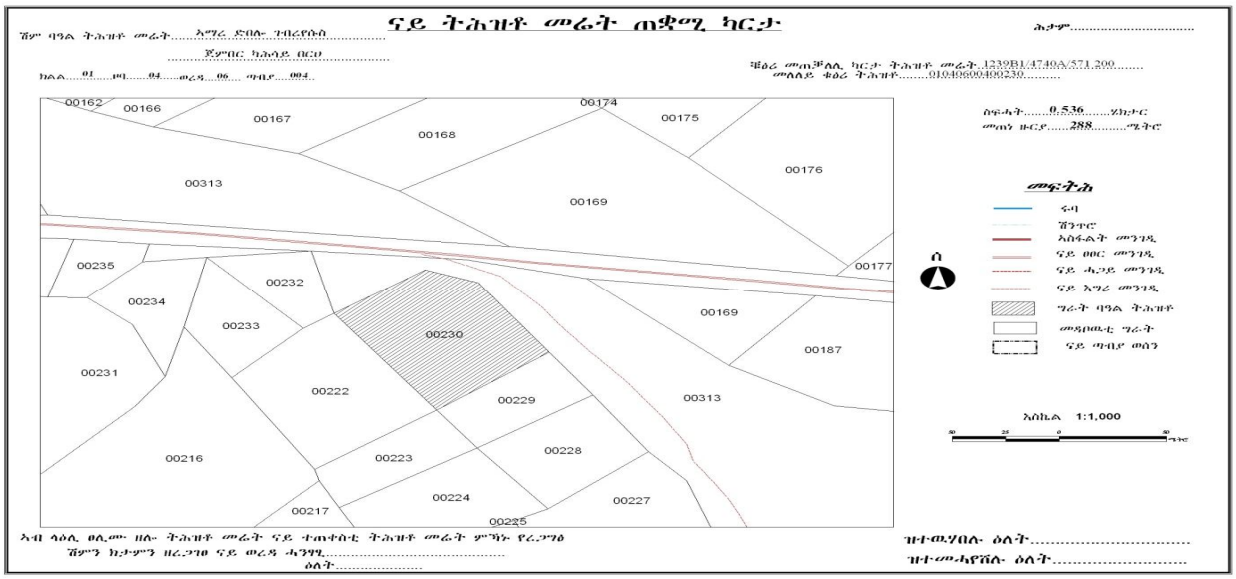
Table4.3 key features of the land registration process in sample kebeles of Raya Azebo wereda

kebele	*Parcel surveyed*	*Certificate prepared*	*Certificate issued based on type*				***Total***	*Certified Households*		
			Cultivated land	***Homestead***	***Communal land***	***others***		***Male headed***	***Female headed***	***Total***
Wargba	4,717	4,690	3,035	998	35	4	4,072	1,532	824	2,356
Tsegae	6,963	6,910	4,852	1,371	41	9	6,273	1,954	1,137	3,091
Hawelti	6,799	6,466	4,061	1,834	42	60	5,997	2,275	1,416	3,691
Total	18,479	18066	11948	4203	118	73	16342	5761	3377	9138

Source: Tigray Environmental Protection, Land Administration and Use Agency (TEPLAUA), 2012

Annex 3 shows in most locations public meetings were held before and during the certification process, land use committees (LACs) were publicly elected and represented most of the sub-kebeles; and adjudication demarcation was carried out in the field in the presence of neighbors. The land certification was issued in the name of husband and wife if the land is possessed together (joint titling).

Figure 2 sample map of landholder's parcel

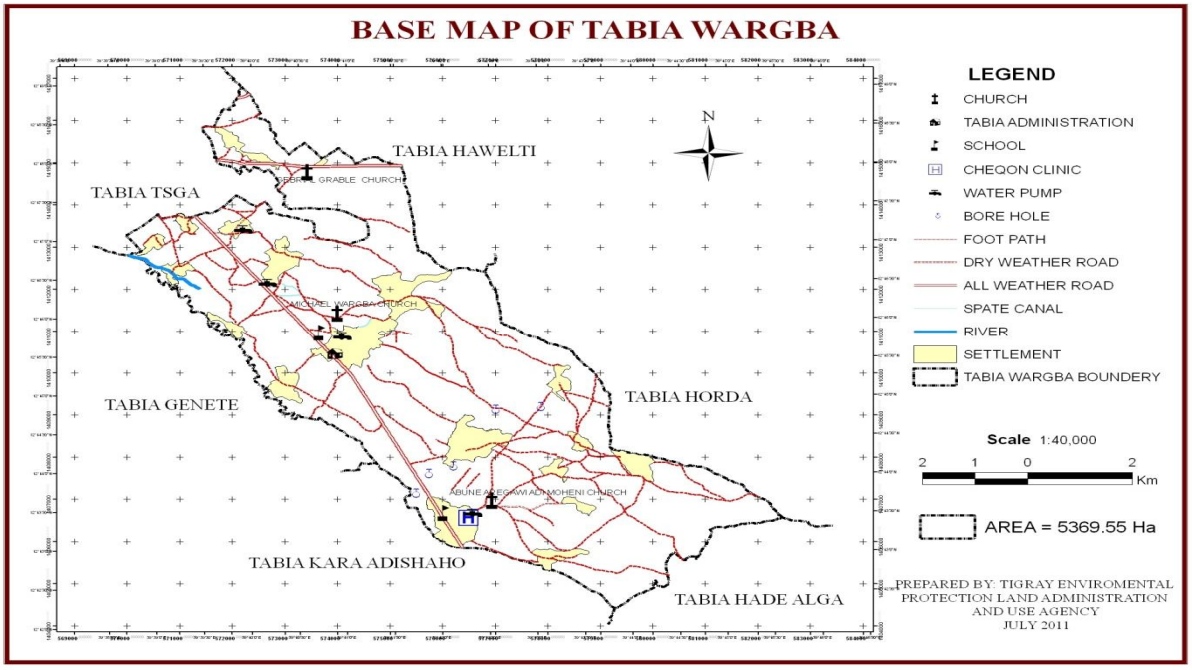


Source: TEPLAUA, 2011

How and when each parcel of land was held is registered at field level; and upon completion of parcel registration, a card is given to the individual, which indicates that the land registration for the individual has been completed. The information on the card as stated in figure 2 above includes: the serial number, Wereda, Kebele, name of land holders (joint titling), maps with detail demarcation for each parcel, codes of parcels, registration date, different certificate received for each parcel homesteaded land and grand index card for holder, name of recorder and a notice to the land holder that he has to bring with him the card to claim for a book of holding.

In addition to household certificates base line map was prepared for each certified tabia used as reference and as base for the implementation of the surviving, registration and certification programs.

Figure 3 sample base map of tabia Wargba



Source: TEPLAUA, 2011

With almost 89 percent of the certified households and 73 percent of households from non certified group indicating that information meetings were organized before the start of registration and 66 and 52 percent respectively, household member had attend such meetings at least once. This is supported by the fact that almost 69 percent of households consider themselves to be well

informed about the program and 70 percents believe that the efforts made by the governments considered as good enough.

Even if farmers are receiving the certificate the government of the region costing to this program which uses more advanced modern technologies including aerial photos, high resolution satellite imagery (HRSI), global positioning system (GPS) and well trained experts. The process is much more costly than the previous first stage land certification. A detailed payment norm of the country's average standard is prepared as below:

Table4.4 Cadastral serving, registration and certification payment Norm

S.N	***Activity***	***Unit***	***Proposed payment norm (ETB)***
1	Surveying and related	Parcel	29.10
2	Registration related excluding kebele base map preparation	Parcel/km	21.70
3	Certification activity	Parcel	10.45
Total			**6 1.25**

Source: Ministry of Agriculture, 2012/13

To put these figures into perspective, it is useful to compare them to the past low cost land certificate and other countries land titling. In Madagascar, where the official cost for titling on demand estimated amount to US$ 150 (Jacoby and Minten 2006), In Uganda, the cost of issuing certificates of customary is some US $ 40 per parcel. By all measures this parcel based second level land holding certificate can considered as still cheaper. Although low by international standards, the cost of the process is still above the level where, in line with households' stated willingness to pay (the non certified households) of birr 54 even if 86 percent of households from non certified group strongly need this certificate, full cost recovery will not be possible. .

4.1.3 Subjective Perceptions and Investment Impacts of Certificate

Perceptions by sample households on impacts of certification are presented in Annex's 3. About 90 percent expect that compensation be paid for land that will be taken, out of this cloth to 91 percent and 90 percent from the certified and non certified group respectively, expects that certification makes receipt of compensation. With similar percentage (68) of the certified and non certified households perceive certification to increase incentives for investment in trees, soil and water conservation structures.

Majority of households (88%) expect certification improve women's position (empowered women's in decision making within the household) and tenure security. 83 percent of certified household and 82 percent of non certified household expects certificate make them more willing to rent out their land to strangers and most of them (86% of the certified and 82 of non certified) perceive that certificate make land market easy and secure.

83 percent of the Non-certified households and 77.7 percent of certified household perceive tree planting enhance tenure security and majority of the households (76.65% and 73.21% non-certified and certified respectively) have interest to plant tree in their plot if it is legally permitted. 91.6 and 36.53 percent of non certified household 95.5 and 43.75 percent of household from certified group respectively, reflect their interest on adoption of soil bound construction and stone terracing.

In relation to investment in improving the existing conservation, Most of the household from both groups (73%) improve the existing soil bound or stone terrace. Cloth 21 percent of respondents made nothing (response no change) for the existing bound. Majority of the households (93.75%, 92.81% of certified and Non-certified) believe investment on land (soil bound and stone terraces) enhance land productivity, which shows awareness towards the benefits of investment is not as much serious problem in the society. Similarly, 82 percent of Non-certified households and 76 percent of certified household plot, receive public investment. Though clearly encouraging, this positive assessment may be biased, and should be backed up with direct evidence on actual investment behavior.

4.1.3.1 Tenure Type/ Documentation as a Measure of Tenure Security

The incidence of documentation can be compared with the situations prior to the parcel based second level land holding certificates to determine whether tenure security has improved and remains improved as a result of the certificate. Prior to the program 84.6 percent of the respondents have the first stage certificate and the remaining 15.4 percent held no documentation, Out of this 28 % receives the new parcel land holding certificate for their plot. In addition, 42.4 percent of households having the first stage certificate receive the second stage certificate. Taking land certification in the name of the owner as indicator of tenure security, this indicates an increase in formal or objective security from the first stage registered which is only in the name of the head and all parcels in one without clear demarcations to the second stage and more advanced

since it is parcel based with clear and scientific demarcations can be considered as better security improvements.

Table4.5 Number of conversions from first stage to the second stage certificate

Dummy of hh have first stage certificate	***Dummy of hh have PBSLLH certificate for his plot***		
	Non certified	***Certified***	***Total***
No	31(72%)	12(28%)	43(15.4%)
Yes	136(57.6%)	100(42.4%)	236(84.6%)
Total	167(59.9%)	112(40.1%)	279(100%)

Source: own survey, 2013

The number of conversions from the first stage to second stage land holding certificate can also be used as an indicator of increased tenure security.

4.1.3.2 Perception as a Measure of Tenure Security

Perceptions of security were directly queried by asking how likely they can counterclaim for ownership of the parcel at hand. The considerable households of the non certified respondents, 46.4% percent felt secure enough to state that it was impossible for a counterclaim to challenge their claim as indicated in Table 4.7 below. Whereas, 83 percent of the respondents from the treated group can considered as secure enough since they can counterclaim for owner ship of the plot.

Table4.6Households perception of tenure security

Questions asked to sample household	**Non-certified**	**Certified**	**Full sample**
How likely counterclaim for owner ship of the plot?			
Impossible	46.39	10.71	32.01
unlikely	14.46	4.46	10.43
likely	34.94	83.04	54.32
No-change	4.22	1.79	3.24
Is there any improvement of tenure security enhancing measure taken place within the last 2 years?			
Worsen/reduced	7.78	1.79	5.38
No change	50.90	24.11	40.14
Improve	41.32	74.11	54.48

Source: own survey, 2013

From the above one can easily says those certified households have better confidence on the ownership of the plot at hand even if it is difficult to claim this is because of certificate without confirming this result with the help of econometric investigations. Concerning to the change in

tenure security, 41.3 and 74.1 percent of the households from the control and treated respectively, believes that there is tenure security improvement in the last two years. Whereas majority of the respondents from the control group (cloth to 58%) assumes tenure security enhancing measures either reduced or no change taken place in the last two years.

4.1.4 Average Input Use by Treatment Category

To farther shade light on the treatment category, the researcher analyzed average input use in production which probably affects productivity. Starting with average own land holding (farm size) there is some difference between the certified and non certified households (cloth to 0.4 tsimdi). Besides land being a major input in agriculture, plot characteristics (soil quality and slope) has to be considered in productivity. For this data there is no considerable difference in labor usage (average of 36.7 Labor Day) and tropical livestock unit, which is 4.92 and 4.56 units for certified and non certified households respectively(see annex 3 for details).

Certified households have used fertilizer and improved seed that is worth of 906.2 and 138.7 birr respectively. Similarly, households from Non-certified group has used fertilizer and improved seed which worth of 618.5 and 113.6 birr respectively. Similarly, 53 percent of the certified and cloth to 40 percent of Non-certified households use manure for their plot (see Annex 3 for detail).

4.1.5 Outcome variables by Treatment Category

Level of the outcome variables among different treatment category, as described in Table 4.8 below, provide a first check of our hypotheses. Plot ownership indicator, asking land owners whether they were fear for his holding at hand may take/grab by the government at any time, 71 percent of non treated households and 12 percent from the treated household's fears there holding may take by the government at any time. This shows the non certified household loses their confidence (feel in secured) as compare to the certified one. And the difference is statistically significant at 1percent level of significance. Similarly, taking the degree of confidence as measure of tenure security, also points to significantly higher level of tenure insecurity in the control group (64 percent) as compared to the treatment group (22 percent) of the households in the survey.

With regard to land related investment, as depicted in Table 4.8, the number of tree seedlings (tree planted in the last two years) higher in control group (92.88) than the treated households (61.95). But this lacks statistical significance. That is insecure household invest more in tenure security

enhancing factors (tree planting) as compared to household under the treated village even if it needs deep empirical investigation which were stated in the econometric part below. But the standard deviation is more than two times larger than the mean shows there is great variation among the invested households.

Table4.7 Outcome variables by Treatment Category

Household level indicator	***Non -Certified***		***certified***		***Diff.***	***t-test***
	Mean	**Std. Dev**	**mean**	**Std. Dev**		
Tuner security indicators (household level)						
Fear his holding may take by gov't at any time	.72	.45	.12	.33	.60***	12.1513
Certain to cultivate the same field after five years	.26	.44	.86	.35	-.598 ***	-12.158
Land related investment over the last 18 months (plot level)						
Tree seedlings	92.88	176.37	61.95	138.01	30.92**	1.5760
Adopt soil bound in the last 18 month.	.62	.49	.89	.32	-.27***	-5.2008
Length of soil bound constructed in last 18 months	165.69	244.68	152.80	201.57	12.89	0.4657
Adopt stone terraces in the last 18 months	.19	.39	.344	.477	-.15 ***	-2.9579
Intensity of ST constructed in the last 18 months	11.15	81.43	14.15	149.86	-2.99	-0.3577
Land productivity indicator (plot level)						
Total value of output per ha	2852.4	7004.8	3746.3	6650.9	-893.89	-1.0727

Source: Own survey data, 2013

Our data also contain information on whether households undertook new land-related investment, mainly on terracing and bounding, during the last 18 months as well as the intensity of such investment if any of household on his plot. This shows majority of the households from treated group have significantly adopt soil bound as compared to the control group. 62 percent of the household from the control group and 89 percent from treated group adopt soil bound in the last 18 months and it is statistically significant and consistent to the hypotheses that certificate enhance decision to adopt new technology such as soil bound. There is no significant difference in intensity of soil bound constructed structure in the control and treated group. The mean intensity (length) of land soil bound conservation structure 165.69 meters in the control group and 152.80 in the treated group plot. This is far less than the average requirement of 700 meters per hectare of stone terrace or soil bounds to conserve hectare of land from soil erosion effectively on typical sloped area in the north Ethiopia, as estimated by Gebremedhin and Swinton (2003) even if such type of investment may get in touch with through time.

Moreover, 19 and 34 percent of respondent households from the control group and the treated group respectively, have adopted new stone terrace in the last 18 months. This is statistically significant and consistent to the hypothesis even if it is far less than the number of households soil bound constructed stated above. Similarly, plots of certified households receive 11.15 meters of stone terrace investment and in plots of non-certified households recives14.15 meters of stone terrace. Similar to the interpretation in the tree seedlings the standard deviation was very large which shows the variation of the intensity of stone terrace construction was too large.

Total values of output produced per hectare, as stated above shows that yield appear to be higher on plots with certificate than on plots without certificate even if the difference is not very large.

Though majority of the results are consistent to the hypothesis, this positive results may be biased and my lead as to incorrect conclusion, and need to further investigation with well specified parametric models to confirm this results.

4.2 Estimation of the Propensity Score

This part presents the results of logistic regression model employed to estimate the propensity scores for matching treatment households with control households. The dependent variable is binary indicating whether the household received the parcel based second level land holding certificate which takes value one if he receives (he is from the pilot or treated village) and 0 otherwise. STATA version 11.0 was used for computing the propensity score matching.

This study investigates whether program placement in tabia/village has any impact on nonparticipants the results (see annex 4) does not shows any spillover effects.

Table 4.9 (and Annex 5) shows the estimation results of logit model. The common support option has been selected and the balancing property was satisfied. Thus, with availability data the region of common supports was [0.19059294, 0.76650343]. This implies that PSNP beneficiaries and non-PSNP beneficiaries whose propensity scores below 0.19059294 and above 0.76650343 were

discarded and balancing propensity also satisfied at this common support region. The pseudo-R2 value of the estimated model result is 0.0490 which is fairly low. This low pseudo-R2 value indicates that the allocation of the program has been fairly random (Pradhan and Rawlings, 2002). The result therefore, suggests that treatment households do not have diverse characteristics over all and hence obtaining a good match between treatment and control households becomes easier**.**

The estimated coefficients indicate that all household and plot level characteristics except own land size did not provide strong evidence for household to receive certificate. Households with higher land size have lower probability of receiving second certificate and it is statistically significant at 10 percent level of significance.

To ensure that variables are not affected by participation in the program, they should either be fixed over time or measured before participation (Rosenbaum and Rubin, 1983). These variables are believed to be time invariant control variables and are commonly used in most impact literature. To minimize contamination with participation some variables such as livestock holding, number of oxen owned, length of soil bound constructed and stone terrace before the program started are used for the estimation.

Since the program is pilot under specific villages introducing village dummy make the estimation results completely unmatched which shows village dummy as the perfect predictor of the program. The remaining pre treatment variables are also found to be statistically insignificant to affect households to receive the second level certificate.

Table4.8 Logit estimation for probability of participation in the certification program

VARIABLES	Coefficients	Std. Err.	P>|z|
Sex of the household head, 1=male, 0= female	-.2019937	.3425613	0.555
Age of household head	.013868	.0118475	0.242
education of the household head, 1=literate, 0=illiterate	.0539247	.3243889	0.868
Number of adult male's for the household	.0391765	.0904928	0.665
Own farm size in "Tsimdi"	-.1160193*	.05906	0.049
Average distance from plot to homestead	-.1106197	.0932755	0.236
Number of years plot possessed	.0151612	.0214275	0.479
Dummy of household have first stage certificate for his plot	.4622918	.4220351	0.273
Soil type: Ba'ekel	-.0559994	.496848	0.910
Soil type: Walka	-.5356318	.3481641	0.124
Soil type: Hutsa	.0658319	.4606702	0.886
Slope: Flat	.7731895	.6507257	0.235
Slope: steep	.6729651	.62606	0.282
Soil depth: Shallow	-.4050932	.2998521	0.177
soil depth: Deep	-.1374403	.2919623	0.638
Number of oxen before participation(2003[6])	-.0380259	.1068069	0.722
Tropical livestock unit in 2003	.0122561	.0160342	0.445
Number of young trees (planted before program)	-.0012474	.0012856	0.332
Soil bound constricted still 2003 (meters)	-.0003772	.0005992	0.529
Stone terrace constricted before participation 2003	.0020384	.0023929	0.394
Constant	-.947692	.8823373	0.283
LR chi2(21)	*18.99*		
Pseudo R2	*0.0501*		
Observations	*279*		

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Own survey data, 2013

[6] The year 2003 shows is Ethiopian calendar

4.3 Parametric Estimation

4.3.1 Tenure Security Impacts of Second Level Land Holding Certificates

To test whether, as predicted, parcel based second level land holding certificate enhance perceived tenure security of farmers or not Table 4.10 presented results from probit estimation on different tenure security indicators. Approximate standard of the estimation results are reported in parentheses beneath the parameter estimate.

In both case of specifications the treatment variable was strongly support our hypothesis. The result suggest that households from the treated villages had higher level of tenure security i.e perceives significantly less fear of land taking by the government or any other agents at any time and certain to cultivate the same field after five year. This is consistent to the one done by Deininger et al. (2009) on impacts of first level land certificate on tenure security in the same country. This also in line to the descriptive evidence that points majority of the households from the treated village has better perceived tenure security as compared to households from non treated villages.

From this one can conclude that second level land holding certificate have significant role on building of the perception of tenure security and countries like Ethiopia with land redistribution experienced under successive governments and having proclamination that guarantees for every individual over the age of 18 years will have access to rural land if he/she desires to engage in agriculture needs continuous updates of registration and certification to enhance tenure security and efficient use of the scarce resource. So it is possible to consider this second level land holding certificate have significant rule in country like Ethiopia to enhance tenure security and this certification with the help of modern technologies can considered as appropriate policy direction.

Another alternative way of estimation of the impacts of the parcel based second level land holding certificate on perceived tenure security was the instrumental variable probit approach. Since the endogenous variable (in case if certificate is endogenous) was discrete and the dependent variable was also binary the iv-probit approach can considered it as alternative estimator. In this case since village and certification are inseparable; village dummy was perfect predictor of the program. So, village dummy and year with certificate are used as relevant instrumental variables.

Table4.9 Impacts of parcel based second level land holding certificate on perceived tenure security: probit and instrumental variable probit estimation

VARIABLES	***Probit Estimation***		***Iv-probit Estimation***	
	cert_after5	*Fear land grab*	*cert_after5*	*Fear of Eviction*
certi_type2	2.064***	-2.188***	2.073***	-2.200***
	(0.221)	(0.240)	(0.232)	(0.248)
Sex of the household head, 1=male, 0= female	-0.299	0.433	-0.304	0.438
	(0.270)	(0.285)	(0.274)	(0.288)
Age of household head	0.0852	-0.111**	0.0756	-0.0981*
	(0.0528)	(0.0546)	(0.0522)	(0.0534)
Age square of household head	-0.00074	0.000979*	-0.0007	0.0009*
	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Education of the household head, 1=literate, 0=illiterate	-0.450*	0.567**	-0.421*	0.529**
	(0.239)	(0.245)	(0.239)	(0.243)
Number of dependants for the household	0.0766	-0.115*	0.0607	-0.0973
	(0.0680)	(0.0694)	(0.0687)	(0.0696)
Number of adult for the household	-0.125*	0.142*	-0.122	0.137*
	(0.0727)	(0.0743)	(0.0744)	(0.0755)
Own farm size in "Tsimdi"	-0.0275	0.0180	-0.00481	-0.00886
	(0.0409)	(0.0418)	(0.0379)	(0.0386)
Plot-home distance	0.0358	-0.0150	0.0927	-0.0814
	(0.0748)	(0.0762)	(0.0664)	(0.0671)
Number of years plot possessed	-0.0151	0.0166	-0.0158	0.0172
	(0.0170)	(0.0175)	(0.0171)	(0.0175)
Dummy of household have first stage certificate for his plot	0.364	-0.351	0.261	-0.236
	(0.308)	(0.313)	(0.306)	(0.310)
Number of oxen	0.0205	-0.0256	0.0163	-0.0174
	(0.0919)	(0.0952)	(0.0933)	(0.0959)
Tropical livestock unit	-0.0227*	0.0258*	-0.0238	0.0272*
	(0.0137)	(0.0143)	(0.0150)	(0.0162)
Soil type: *Ba'ekel*	1.419***	-1.476***	1.413***	-1.472***
	(0.405)	(0.415)	(0.411)	(0.417)
Soil type: *Walka*	0.568**	-0.587**	0.571**	-0.591**
	(0.264)	(0.272)	(0.270)	(0.277)
Soil type: *Hutsa*	0.462	-0.510	0.436	-0.477
	(0.332)	(0.342)	(0.332)	(0.340)
Slope: Flat	0.284	-0.360	0.190	-0.238
	(0.525)	(0.552)	(0.512)	(0.526)
Slope: steep	0.996**	-1.260**	0.834*	-1.064**
	(0.491)	(0.508)	(0.482)	(0.491)
Soil depth: Shallow	-0.0349	0.128	-0.0289	0.113
	(0.223)	(0.230)	(0.225)	(0.232)
Soil depth: Deep	0.144	-0.115	0.173	-0.149
	(0.219)	(0.225)	(0.220)	(0.226)
Young tree	-0.000686	0.000789	-0.000819	0.000886
	(0.000969)	(0.00101)	(0.000912)	(0.000957)

Constant	-3.359**	3.919***	-3.076**	3.548***
	(1.316)	(1.362)	(1.302)	(1.329)
Log likelihood	*-117.63176*	*-122.5701*	-	-
LR chi2(21)	*145.79*	*155.04*	*93.23*	*93.56*
Prob > chi2	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Pseudo R2	*0.3826*	*0.4078*	-	-
Observations	*275*	*275*	*279*	*279*

Notes: the first dependent variable takes value 1 if the household is certain to cultivate the same field after five years, and o, otherwise. The second dependent variable is whether the household fear for land taking (fear of eviction) at any time =1 and 0, otherwise.

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: own survey, 2013

The results from instrumental variable probit estimation are quite similar to the above. But the standard errors of the instrumental variables are little bit big, shows the direct probit estimation was efficient. This similarity in coefficient of the variables shows the program (the treatment category) was random, bias is very small and tests have the desired size. In terms of the explanatory variables in both the direct probit estimation and instrumental probit estimation are quite similar in both in magnitude and the direction of correlations

Age exhibits an inverted U-shaped relationship with land security indicators, suggesting that life cycle affects households fear for land grab. This is consistent to the hypothesis and the signs are largely expected. It is also similar to finding obtained by Deininger et al. (2009) and consistent with that administration measures aim to redistribute productive resource among new generation since land is the basic resource for rural livelihood. The opposite is true for number of adult in the household on the fear for land grab specification. We haven't strong interpretation for this result.

Better educated household and household having better amount of tropical livestock unit (may considered as indicator of wealth) fear for land grab and are not certain to cultivate the same field after five years. This Suggests that educated households may leave the village for searching alternative jobs and lose their holding if they are disappeared from the village for more than two years and wealthier households may expect the system that aims redistribution of limited amount of communal land as equity as possible among rural residents.

Plot characteristics, good soil quality indicators among others, significantly and negatively affects for fear of land evection/taking and positively affects for certainty to cultivate the same field. This may be due to either the government officials are not good enough on separating soil

quality or land distribution and taking are focuses on the uncomfortable but not owned by anyone. This is attributable to the policy direction of the government focusing land distribution for the youth under the rural youth package implemented in past six to seven years. Households with steep slope plot perceives significantly better secure as comper to households with medium slope type. Since steep slope is not as much comfortable for agriculture as comper to the other slope no one may need to take land from this rather than the holders need themselves requires another land.

4.3.2 Impacts of second level certificate on investment on land

The first step of the analysis of impacts of parcel based second level land holding certificate on investment consisted of testing the Tobit model against the alternative of Double-Hurdle model. The appropriateness of the Tobit versus the double hurdle can be tested with a likelihood ratio test. The likelihood ratio statistic is calculated as presented in the original Cragg's, (1971) model as:

$$LR = -2[\ln LF_{Tobit} - (\ln LF_{probit} + \ln LF_{truncreg})]$$

Where, LF represents the maximized log likelihood function values for the model type indicated in the subscript, each of which is estimated independently. The null hypothesis is that the Tobit model is appropriate specification. If the calculated likelihood ratio statistics exceeds the critical chi-square with number of degrees of freedom equal to the number of explanatory variables(X) the Tobit is rejected in favor of the double hurdle model.

The results of the formal Tobit and double hurdle as indicated in Table 4.10 below represent the overwhelming evidence of the superiority of the double hurdle model. Based on the log-likelihood values of the two models estimated, the LR test results suggest the rejection of the Tobit model. That is, the test statistic Γ=215.25 for soil bound and 186.05 for the stone terrace exceeds the critical value of the $\chi^2(25)$ =44.31distribution. For good measure, Akaike's Information Criterion (AIC) is included as alternative model selection criterion in addition to log-likelihood ratio tests. The model with the lowest AIC is preferred. Both confirm superiority of the double-hurdle specification over Tobit model. This suggests that the decision to adoption and intensity of adoption (how much to invest) are separate at least for this data set. It also indicates there are variables that affects adoption decision but not affect the intensity of adoption and vice versa. Even variables that affect decision equation may affect intensity of investment but in

different magnitude or directions. This encourages the researcher to focuses on the double hurdle model. So result from the Tobit model is not reported in the analysis.

Table4.10 Test for comparison of Tobit with Double-Hurdle model

Diagnostic test type	***Soil Bound***			***Stone Terrace***		
	Tobit	***Double-Hurdle model***		***Tobit***	***Double-Hurdle model***	
		Probit, D	***Truncated regression Y(Y>0)***		***Probit, D***	***Truncated regression Y(Y>0)***
Wald $x^2(25)$	214.01	158.08	38.58	74.98	43.08	80.73
Prob>x^2	0.00***	0.00***	0.0407**	0.00***	0.013**	0.00***
LOG-L	-1378.7676	-46.577	-1224.56	-496.9908	-126.958	-277.01
AIC (-LOG-L+k/N)	5.104	0.260	4.54	1.899	0.552	1.098
Number of observations (N)	275	275	210	275	275	70
X^2-test: Double hurdle vs. Tobit	**Γ =215.25 > $\chi^2(25)$ =44.31**			**Γ = 186.0456 > $\chi^2(25)$ =44.31**		

X^2-test:*statistically significant at 1% level ** at 5% level of significance , *k = number of parameters***

Source: own survey, 2013

4.3.2.1 Certificate Verses Adoption Decision

The second Hypothesis of study states that parcel based second level land holding certificate enhance investment such as soil conservation bound. To test the hypothesis the double hurdle model (probit specification for adoption decision and alternative truncated regressions on the actual zeros and predicted zeros from probit regression) and alternative Tobit specification are run. But the likelihood ratio test of model appropriates rejects the Tobit model in favour of the double hurdle model (see result of the test in Table 10). This encourages the research to separately estimate adoption decision and intensity of adoption.

The results from the double hurdle model are presented in Table 4.11 below. The Table reports the estimates of the coefficients from robust standard errors of probit model on adoption decision. The pseudo-R square, the chi-square test results and likelihood ratio test are also presented at the bottom of the Table. The likelihood ratio shows that the model is a good fit overall. The pseudo R-square also shows that the regression explains 70.4 percent (which is large for cross-sectional data set) of the soil bound and 18.6 percent of the stone terrace of the total variation in the dependent variable.

Since the interest of this study was to check the impacts of the certificate on decision to invest, we retain all possible alternative estimation strategies which are pass the appropriate tests.

Results consistently suggest that the second level land holding certificate pointed to statistically significant and economically meaningful impacts on decision to adopt soil conservation bound and stone terrace. It is significant at least 1 percent for the soil conservation bound and at 5 percent for the terrace model, which provides strong evidence of a positive effect of certification on investment. The marginal effect indicates that, the treated households has had 8.5 percent more probability of investing soil bound and 12.6 percent more probability of investing stone terrace as compared to the households from the control village. Empirical evidence insures this fact Ghebru et al. (2008) and Deininger et al. (2011)

In line with findings by Kabubo (2010) age has negatively and significantly associated with decision to invest soil bound. Same but insignificant effects also observed for adoption of stone terrace. The marginal effect for literate household indicates that literate households has 14.84 more likely to invest stone terrace as compare to illiterate households, but have no significant role in decision to adopt soil bound construction. Number of parcels for the household have negative and significant (at 10 percent) effects on decision to invest. The marginal effect shows that, as the number of parcel for the household increases by one the probability of adoption was decreased by 9 percent. The propensity to undertake investment was significantly higher in plots possessed for larger period of time than in plots with lower age, old age plots can be considered as indicator of secured plot.

Steepness of the parcel has negative effects on the decision to construct conservation structures, with flat slope parcels being less likely to have investments relative to those with a moderate slope, which is consistent with Nyangena (2007), Zikhali (2008) and Gebremedihn and Swinton (2003).this suggests as the extreme slopes households less likely to invest in steep slope may be due to less economic benefits and less likely to invest in flat slope due to more secure slope from soil erosions and flood.

Table4.11Impacts of parcel based second level land holding certificate on decision to adopt soil bound and stone terrace: probit estimation

VARIABLES	Adoption Soil Bound		Adoption Stone Terraces	
	Coefficient (robust standard error)	*Marginal effect*	*Coefficient (robust standard error)*	*Marginal effect*
certi_type2	**0.988(0.373)*** **	**.0857**	**0.407(0.195)** **	**.1266**
Sex of the household head, 1=male, 0= female	0.707(0.420)*	.0932	-0.105(0.230)	-.0327
Age of household head	-0.035(0.014)**	-.0034	-0.006(0.009)	-.0017
Education of the household head, 1=literate, 0=illiterate	-0.656(0.424)	-.0834	0.449(0.219)**	.1484
Log of number of adult males	0.085(0.388)	.0077	-0.210(0.265)	-.0641
Log of number of adult female	-0.049(0.473)	-.0045	0.038(0.270)	.0115
Number of dependants for the hh.	-0.013(0.104)	-.0012	-0.036(0.075)	-.0111
Tropical livestock unit	-0.007(0.019)	-.0007	0.009(0.009)	0027
Own farm size in "Tsimdi"	0.047(0.061)	.0043	0.030(0.042)	.0092
Number of parcels	-0.260(0.193)	-.0237	-0.296(0.179)*	-.0904
Plot-home distance	0.138(0.117)	.0126	0.065(0.065)	.0199
Number of years plot possessed	0.046(0.023)**	.0044	0.022(0.015)	.0068
Dummy of household have first stage certificate for his plot	-0.592(0.422)	-.0384	0.222(0.304)	.0637
Soil type: *Ba'ekel*	0.996(0.761)	.0465	-0.216(0.366)	-.0613
Soil type: *Walka*	0.646(0.468)	.0738	0.041(0.231)	.0125
Soil type: *Hutsa*	0.505(0.470)	.0355	0.175(0.297)	.0555
Slope: Flat	-1.319(0.622)**	-.0543	0.430(0.425)	.1138
Slope: steep	-1.438(0.629)**	-.2904	-0.116(0.398)	-.0343
Soil depth: Shallow	1.177(0.369)***	.1043	0.483(0.204)**	.1503
Soil depth: Deep	-0.777(0.338)**	-.0735	-0.255(0.208)	-.0777
Dummy of Public investment	0.947(0.367)***	.0570	0.106(0.223)	.0331
Number of contact/visits	0.268(0.0819)***	.0245	0.027(0.044)	.0083
iner_invPro	3.292(0.350)***	.6838	0.113(0.215)	.0339
SWC_2003	0.003(0.001)***	.0003	0.013(0.006)**	.0038
Young tree	-0.002(0.001)	-.0001	-0.001(0.001)	-.0001
Constant	-0.348(1.090)		-1.572(0.717)**	
Wald chi2(25)	*158.08*	-	*43.08*	-
Prob>chi2	*0.0000*	-	*0.013*	-
Pseudo R2	*0.709*	-	*0.1862*	-
Pseudo likelihood	*-46.577*	-	*-126.958*	-
Observations	*275*	*275*	*275*	*275*

Source: own survey, 2013

robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Taking perceived soil depth and soil type as an indicator of soil quality or degree of fertility, shallow soil depth are more likely to adopt soil conservation bound and stone terrace. This can be interpreted as, plots with shallow soil depth has 10.4 percent and 15 percent more probability to receive soil bound and stone terrace construction respectively. This indicates that households adopts this technology more likely on the plots more vulnerability to soil erosion to control the plot from flood and related disasters. Similarly, parcels with deep soil depth are less likely to receive soil bound and it is statistically significant at 5 percent level of significance. Not surprisingly this finding also supports the finding of Zikhali (2008). Plots received public investment also had more likelihood of adopting soil bound as compared to the plots without public investments. This is consistent with the finding of Ghebru (2008).

The results also show that, households that invest on their land establish and/or enhance land productivity. Specifically, those who believe investing on land enhance land productivity, more likely to invest in soil conservation and statistically significant at the extreme level. Existing SWC /ST assets on a plot are positively correlated with the probability of making new investments. This implies that additional investment is more likely to be made on plots with past soil conservation/stone terrace improvements. This may be due to understanding the benefits from such types of investment. Households contact with extension workers and visit different better performing farmers are more likely to adopt soil conservation bound in their plot.

4.3.2.2 Impacts of Certificate on Intensity of Investment

Third hypothesis states certificate may not have significant role on intensity of investment. In other words, other variables rather than certificates enhance intensity of investment conditioned that investment is made. To test this hypothesis the second stage of the double hurdle model, truncated regression model on the actual zeros and the predicted zeros from the probit regression was run on those who pass the first hurdle to measure intensity of adoption among adopters.

The results for the intensity of soil conservation bound and stone terrace are presented in table 4.12 below. The ancillary statistic/sigma which estimates standard error of the regression in the truncated regression was significant.

The variable that affects adoption decision also affects for the intensity of adoption in different directions. The second level land holding certificate affects both intensity of investment of soil

bound and stone terrace negatively and significantly. Which is beyond the expected which indicate that decision to invest is higher in the certified households but among the household who pass the first hurdle (those who already invest) the intensity of investment is higher in the non certified households. The result that certificate had negative and significant effects on intensity of investment, suggests that even if the likely hood of adopting soil and water conservation bound and stone terrace is higher for the certified households, the intensity of investment is larger in the households from the non certified group conditioned that investment is taken place. So certificate affects decision to adopt and intensity of adoption in different directions, which is beyond the expectation. The adverse effects of the certificate on intensity of investments need deep investigation with more robust methods such as panel data.

Taking household characteristics in to consideration, Age has negatively and significantly associated with intensity of investment on the truncated regression with the actual zero specification of soil bound and in all specifications of the stone terrace. Younger households may have more energy to engage in labor intensive conservation practices but decrease as age increases, which is consistent to the finding done by Kabubo (2010). Male headed households invest less amount of investment in both stone terrace and soil bound. It is statistically significant in both specification of stone terrace. This is unexpected but this may be either due to majority of the female headed households are from the non certified households or since women are worried about future land distribution and they are less secure than male and then, would be more likely to engage in medium level security enhancing factors such as stone terrace.

Another surprising result related with was the relationship with intensity of investment and dependency ratio. Dependency ratio have significant and positive role on intensity of investment which is unexpected. But this may indicate as there is high level of child labor which is very common in third world countries like Ethiopia. The effect on intensity of investment of stone terrace was negative, which indicates, having a lot of dependants is demanding in terms of labor hours spent taking care of them and this obviously implies less time spent monitoring parcels which expects lower level of investment and productivity in addition to this investment type needs matured age. Although the signs of the coefficient estimates are consistent with our expectations, there is no compelling statistical support for this hypothesis.

Table4.12impacts of certificate on intensity of use of stone terrace and soil bound: Truncated regression

Variables	**Intensity of soil bound (truncated regression)**		**Intensity of Stone Terrace (Truncated Regression)**	
	Actual non-zero values (Asymmetric standard error)	*Predicted non-zero values from probit (Asymmetric standard error)*	*Actual non-zero values (asymmetric standard error)*	*Predicted non-zero values from probit (asymmetric standard error)*
certi_type2	**-312.5(108.7)*** **	**-306.9(107.5)*** **	**-354.9(184.7)***	**-363.2(188.4)***
sexhh	-203.5(125.7)	-215.8(125.5)*	-265.5(138.2)*	-263.1(138.1)*
agehh	-9.778(4.905)**	-8.301(4.853)*	6.141(4.782)	6.102(4.853)
educhh	-105.7(117.3)	-127.1(119.1)	117.6(123.3)	117.9(125.3)
logadumalha	-222.4(150.7)	-207.3(148.6)	-2.084(175.0)	-6.579(177.4)
logadufemha	-95.37(145.3)	-83.41(143.5)	-112.1(117.2)	-110.5(117.2)
depratio	-4.805(37.07)	-1.497(36.77)	63.66(35.33)*	64.02(35.50)*
tlu	-0.319(5.317)	-0.193(5.269)	-2.748(10.28)	-3.881(11.25)
own_land	-18.56(24.01)	-16.97(23.95)	-72.58(31.40)**	-73.73(31.97)**
no_parcel	161.7(82.66)*	179.6(83.06)**	256.7(82.97)***	259.2(83.86)***
plotdist	-41.95(34.87)	-36.65(34.07)	-131.8(76.26)*	-135.6(78.04)*
plot_age	27.08(9.414)***	24.41(9.160)***	-7.461(12.13)	-7.924(12.31)
first_certi	-50.68(143.7)	-37.99(142.5)	-91.53(228.3)	-88.88(230.5)
bak_type	-4.449(154.0)	-23.37(152.6)	-320.1(297.2)	-322.3(298.2)
walk_type	44.80(121.6)	34.31(120.5)	26.18(143.0)	25.68(145.5)
hut_type	-605.1(206.0)***	-667.6(213.9)***	-503.5(416.7)	-513.0(425.5)
slop1	-546.3(261.4)**	-640.1(272.4)**	484.3(540.9)	471.0(550.0)
slop3	-107.9(221.4)	-166.0(228.1)	433.8(494.3)	429.3(504.0)
sd_shallow	127.2(102.7)	116.5(101.6)	281.0(150.4)*	281.1(151.8)*
sd_deep	6.576(98.99)	0.347(98.10)	-60.93(121.8)	-57.04(123.3)
public_inv	228.7(122.5)*	209.4(120.1)*	148.4(165.4)	155.7(169.2)
extecona	66.60(23.43)***	61.17(22.91)***	6.525(35.30)	5.857(35.90)
iner_invPro	186.8(161.7)	159.2(159.6)	204.6(166.6)	207.5(168.1)
SWC_2003	1.306(0.233)***	1.298(0.231)***		
youngtree	1.127(0.397)***	1.287(0.407)***	-1.972(2.651)	-1.983(2.699)
STC_2003			2.153(0.678)***	2.176(0.693)***
Constant	105.2(407.5)	176.8(411.5)	-766.7(616.9)	-740.4(625.9)
Sigma	*309.7(39.51)****	*307.9(39.16)****	*89.18(19.81)****	*88.76(19.83)****
Wald chi2(25)	*38.17*	*38.19*	*80.73*	*95.31*
Prob>chi2	*0.045*	*0.044*	*0.0000*	*0.0000*
Log likelihood	*-1224.56*	*-1223.53*	*-277.01*	*-329.74*
Observations	*210*	*201*	*70*	*70*

Source: own survey, 2013

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In line to the finding done by Gebremedihn and Swinton (2003), own cultivated land size has negatively associated with intensity of investment and consistent result in both specifications of both investment type, but it lacks the statistical significance in the soil bound model. This

indicates as land size increase intensity of investment at lesser proportion. This is consistent to the hypothesis that more land may reduce the need to conserve land. Reverse effect is also observed on the number of parcels for the households. Households having large number of parcels (fragmented plot) has had less probability of adoption investment but invests more meters conditioned that investment decision is made. This is consistently significant in all specifications of the truncated model.

Annex eight and nine in show the intensity of soil bound and stone terrace (level) investment using the kernel density graph of plots with and without certificate of the matched plots. A two-sample Kolmogorov-Smirnov test for equality of distribution functions for intensity of investment for soil bound and stone terrace was highly Significant (P=0.000 and 0.04, respectively) indicating that the distributions were different. This supports the finding of certified and non certified households have significant difference in intensity of investment conditioned that investment is made.

Distance from homesteaded to plot was also negatively associated with intensity of investment but only significant in the stone terrace model. This indicate the opportunity cost of investing in such distance plot may be high due to the issue of security (plots at far distance from the homesteaded are where frequent land redistribution and may catching to large scale investors often occurs) and the transaction cost of traveling to plot (which already found in the tenure security part that, distance plots are less secured as compare to home stead plot) in addition to the time the owner lost traveling. This is consistent to past litterateurs, near plots get supervision from family (see Gebremedihn and Swinton, 2003; Wogayehu and Drake, 2003 and Kabubo, 2007).

The intensity of undertake investment of soil bound was significantly higher in plots possessed for larger period of time than in plots with lower age, which can be considered as indicator of secured plot. Plot with *hutsa* type of slope receives lower investment in terms of investment as comper to *mekayh* soil type. It is also statistically significant at 1 percent level of significance. Which suggests that, plots with less fertile soils (*hutsa* type consider as poor soil quality as compared to other type) that are expected to give low return(high opportunity cost of investing) and have lower marginal productivity loss of not investing more.

Plots with flat slope have significantly lower level of soil bound construction as comper to plots with moderate slope. It is consistent to the expectation and significant at 5 percent level of significance. This may be due to lower economic benefits of investing in flat slope as compare to the opportunity cost of the area or size of plot lost for this purpose. But plots with steep slope also have the same correlation with intensity of investment as flat slope but not significant, may be due to higher opportunity cost of investing such investment in steep slope type plot. This shows such type of investment take into consideration the relevance (economic gain from investing) and the opportunity cost of investing such investment in decision to invest how much meters.

Taking soil depth in to consideration, shallow soil depth have positive and significant role on intensity of investing stone terrace. A plot with shallow soil depth receives 281 meters more stone terrace than plot with moderate slope. This indicates, when soil depth is shallow, farmers have higher incentive to prevent soil loss and are willing to adopt large intensity of conservation technologies, as there is significant benefit from soil conservation. The empirical studies by (Pender and Kerr, 1998 and Shively, 1999) support this argument.

Public investment received plots and intensity of investment have also positive correlation in both investment types. It is also significant at 10 percent level of significance in case of intensity of soil bound construction. Households' receiving advice from the extension workers and visits are performing average of more than 61 meters of soil bound on his own plot. It is statistically significant at least at 1 percent level of significance.

Past investment also encourages households to invest more. This may be come as a result of the well understanding of productivity benefits of soil conservation bound and stone terrace construction from past experiences. Plots with trees planted before the program participation which can be considered as better tenure security invests more soil bound but less stone terrace. Which indicates soil bound conservation is more of productivity enhancing factor and need more security to invest more and statistically significant at 1 percent level of significance as compare to stone terrace (some researchers in the literature considered stone terrace as security enhancing factors).

4.3.2.3 Impacts of Certificate on Tree Growing on Private Plot

Table 4.13 shows impacts of this parcel based second level landholding certificate on investment in tenure security enhancing factor (visible investment). The results were presented as numbers of tree seedlings using Tobit model with actual certificate variable, year with certificate and different predicted certificate variables separately to compare the results. The rationale behind for using year with certificate as alternative was the nature of the program. The second level land holding certificates took place in the study area in a fairly short period of time. The investment enhancement effect that may have accrued due to the land certification that has reduced plot level tenure insecurity is not likely to appear immediately after receiving land certificates, the perceptions of stronger tenure security must sink in first and then gradually they will start to affect plot level behavioral decisions such as tree planting. To capture this gradual effect, we used the time period (in years) that the individual households have possessed their land certificates. This captures also the variation in timing of allocation of certificates among the certified households to critically identify the impacts.

We hypothesized that investment on land (visible investments like tree planting) is higher on plots without certificates to enhance tenure security than with certificates. Table 4.13 shows that the actual certificate variable, year with certificate and different specification of predicted certificate variable via number of tree seedlings are tested. The certificate variable in both specifications had no significant effect on number of tree seedlings planted in private plot. Although the signs of the coefficient estimates are consistent with our expectations, there is no compelling statistical support for this hypothesis. This may be due to the program is recent and such types of investments needs time to decide in addition to restrictions in tree plants, especially eucalyptus trees, on arable land. We lack statistically significant evidence to accept the alternative hypothesis of more trees in non certified plots.

In addition to certificate variables, other variables also affect households to plant more tree plants. The result suggests that age of the household head affects tree planting negatively. It is also statistically significant at 5 percent level of significance. Households with more number of parcels are plant more tree as compared to lower number of parcels. This may be due to diversification of households to some of the parcels to tree and the other for crop production.

Table4.13Impacts of parcel based second level land holding certificates on tree seedlings using Tobit model with different certificate variables

VARIABLES	Tobit year with certificate	Tobit Actual certificate	Tobit predicted certi1	Tobit predicted certi2
Year with certificate	**-41.10**			
	(29.01)			
Actual certificate use for his plot		**-65.78**		
		(53.50)		
certi1			**-82.00**	
			(57.43)	
certi2				**-82.16**
				(57.42)
Sex of the household head, 1=male, 0= female	27.34	31.66	28.70	28.49
	(73.06)	(73.19)	(72.99)	(72.99)
Age of household head	-4.922**	-4.951**	-4.830*	-4.838*
	(2.459)	(2.469)	(2.463)	(2.464)
Education of the household head, 1=literate, 0=illiterate	25.18	22.26	23.08	23.12
	(60.27)	(60.46)	(60.29)	(60.29)
logadumalha	-8.202	-6.338	-5.628	-5.597
	(67.85)	(68.01)	(67.75)	(67.74)
logadufemha	91.59	87.09	87.91	87.77
	(71.88)	(72.02)	(71.69)	(71.68)
logtluha	-8.248	-8.581	-9.087	-9.078
	(32.54)	(32.72)	(32.61)	(32.60)
Own farm size in "Tsimdi"	1.809	1.859	1.767	1.765
	(12.60)	(12.69)	(12.61)	(12.61)
Number of years plot possessed	-0.905	-1.252	-1.324	-1.322
	(4.108)	(4.102)	(4.101)	(4.100)
Number of parcel	104.6**	108.4**	104.9**	104.9**
	(42.99)	(43.17)	(42.99)	(42.98)
Average distance from plot to homestead	-34.05*	-34.86*	-34.96*	-34.97*
	(18.34)	(18.41)	(18.34)	(18.34)
Dummy of household have first stage certificate	70.66	76.75	77.12	77.26
	(77.35)	(77.75)	(77.47)	(77.47)
Soil type: Ba'ekel	99.32	96.53	95.94	96.01
	(91.75)	(92.13)	(91.84)	(91.82)
Soil type: Walka	80.00	77.39	74.43	74.38
	(67.16)	(67.65)	(67.64)	(67.63)
Soil type: Hutsa	-50.52	-51.90	-53.22	-53.09
	(90.51)	(90.58)	(90.50)	(90.48)
Slope: Flat	-253.6**	-259.7**	-255.5**	-255.4**
	(119.1)	(119.1)	(119.0)	(119.0)
Slope: Steep	-122.3	-126.5	-122.0	-122.1
	(119.1)	(119.2)	(119.1)	(119.1)
Soil depth: Shallow	72.24	72.49	70.65	70.60
	(57.37)	(57.57)	(57.46)	(57.46)
Soil depth: Deep	-26.24	-27.28	-26.94	-26.98
	(56.76)	(56.88)	(56.75)	(56.74)
Interaction variable	185.0***	185.9***	184.9***	185.0***

	(56.02)	(56.28)	(56.01)	(56.00)
Number of Young tree	0.628***	0.620***	0.627***	0.626***
	(0.210)	(0.211)	(0.210)	(0.210)
Number of Natural tree	0.830***	0.839***	0.830***	0.829***
	(0.237)	(0.237)	(0.237)	(0.237)
Number of contacts with DA and visits	34.10***	33.88***	34.18***	34.14***
	(12.59)	(12.70)	(12.60)	(12.59)
Constant	-108.6	-105.9	-96.67	-96.02
	(199.7)	(200.7)	(200.4)	(200.4)
Sigma	310.8***	311.7***	310.8***	310.8***
	(25.77)	(25.84)	(25.76)	(25.76)
LR chi2(23)	*66.87*	*66.37*	*88.78*	*60.48*
Prob >chi2	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Log likelihood	*-743.482*	*-743.733*	*-761.392*	*-761.382*
Pseudo R2	*0.0430*	*0.0427*	*0.0382*	*0.0382*
Observations	*275*	*275*	*279*	*279*

Source: own survey, 2013 *Standard errors in parentheses*
**** p<0.01, ** p<0.05, * p<0.1*

In line to the finding of Mekonnen et al. (2009) in the same region on the impacts of first stage certificate on tree planting and Lunduka (2008) from Malawi, Distance from plot to home also affects tree planting negatively and significantly. This may be due to risk of theft, tenure insecurity and high cost of monitoring treatments. Plot with flat slope invest less amount of tree as compared to plots with medium slope. This is significant and negative suggests that flat slope may not be economically feasible since it is comfortable for crop production and farmers in the study area plant significantly less number of tree as compared to plots with medium slope type. The interaction variable of those households perceives tree planting enhance tenure security and plant tree invest more. It is significant at 5 percent level of significance. This suggests of the households who plants tree majority perceives tree planting enhance tenure security.

The other driving forces for the intensity of tree planting are number of young trees (tree plants before the program introduce), which affects households to plant more tree and it is strongly significant at the extreme level. This indicates that, even though a plot has trees planted before households who have experience on tree planting need to invests more tree since they knows the benefits. This is due to the economic benefits of tree planting which is consistent to the finding of Holden et al. (2003) and Jabber and Pender (2000) which says tree planting especially Eucalyptus may be the most profitable crop to grow for rural households in Ethiopia. The role of local norms and attitudes towards tree planting may differ from the rules stated by the law also. Similar finding which is consistent to that of Mekonnen et al. (2011), contacted with development agents

and visited also encourage farmers to invest more tree as comper to those not contact and visits and to those contacted less. This may be the results of knowledge share and advice received from experts and well experienced farmers.

The number of natural trees on the plot was used as explanatory variable by assuming it have crowding in (that is it would not be necessary for a household to plant trees when the plot already has natural tree) or crowding out effects (may encourage farmers to plant more since they can understand well about the benefits from tree or the plot may not comfortable for crop since tree exists around that). Amazingly, the variable is positive and statistically significant at 1 percent level of significance which is consistent to the one found by Lunduka (2008) in Malawi. This indicates that the more natural trees in own plot, the higher the probability of planting trees. From this one can conclude that, even though a plot has natural trees, a household needs to plant its own trees that it can show to claim ownership of the land.

4.3.4 Productivity Impacts of Certificate

To test the hypothesis that, whether second level land holding certificate enhance productivity or not this study approached using non-parametric matching and parametric OLS models and integrated this by estimating parametrically on the matched sample. Different instrumental variable estimation methods are also reported to check the robustness of the results. To match the program participants with non participants, the propensity score presented in Table 4.10 are used.

Table 4.14 presents results computed from the non parametric estimation. The columns we are interested in to evaluate the impact indicators are labeled as ATT and t-value. Land productivity in value term is converted in to log form. The results from the table show that land productivity on plots with certificate is higher than on plots without certificate except in the reduce matching but not significant. Shows there is no significant difference of productivity among plots with certificate and without certificate. This may came due to two reasons; the first one is Raya Azebo wereda was highly affected by drought for the last two years and the program is also recent and investment on land to enhance land productivity need time observe.

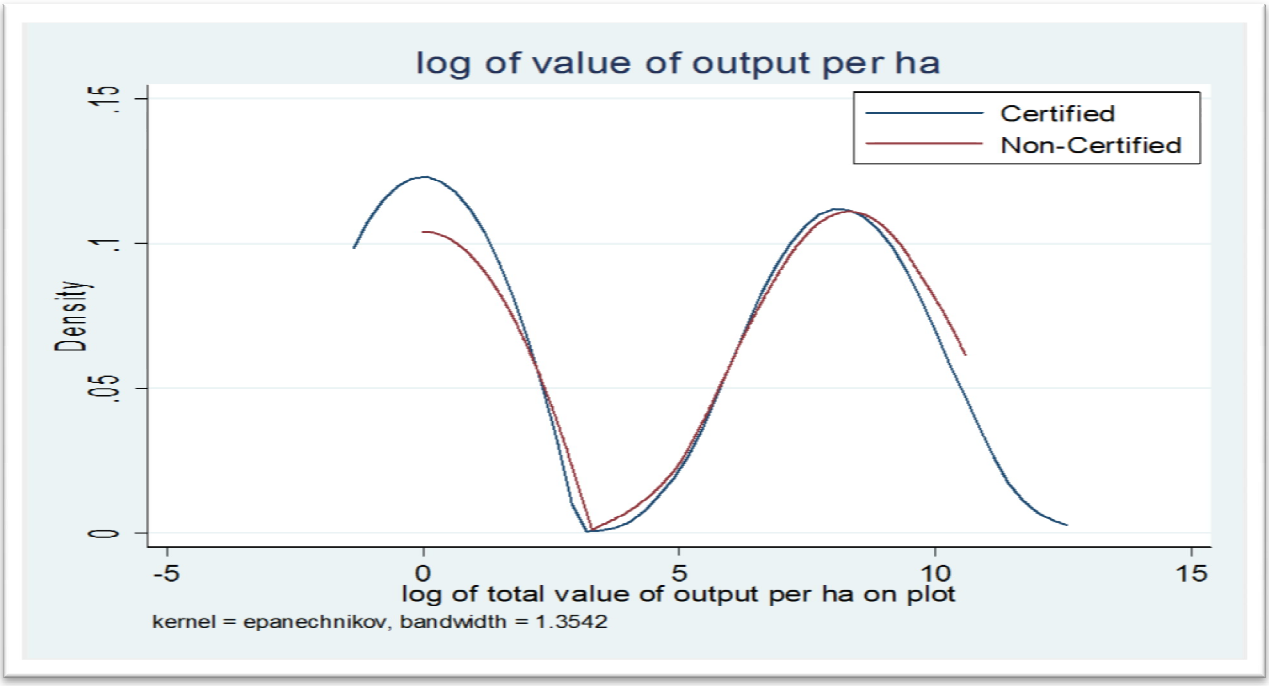
Table4.0.14 ATT estimation results of different matching methods of log of yield per hectare of plots with and without certificate bootstrapped standard errors

Matching method	No. Treated	No. Control	ATT	Std.Err	t-value
Stratification	116	159	0.979	0.548	1.785*
Nearest neighbor	116	72	0.836	0.790	1.058
Radius	112	153	0.515	0.624	0.825
Kernel	116	159	0.821	0.534	1.537

Source own survey, 2013

The yield distribution for plots with and without a certificate was presented in Figure 4.3 below. A two-sample Kolmogorov-Smirnov test for equality of distribution functions of yield per hectare was not Significant (P=0. 681) indicating that the distributions were similar. Which was consistent to the non parametric estimation of certificate have positive but not significant association with productivity.

Figure 4 Kernel density graph of log of yield per hectare for plots with and without certification (matched sample)



Source: own survey, 2013

Next we approached the analysis using different alternative specifications of parametric regression models results of the parametric estimation presents in Table 4.15 containing the actual certificate variable, year with certificate variable and an alternative instrumental estimation of the certificate.

Our instrumental variable estimation of impacts of certificate on productivity follows Ghebru et al. (2008) with little modifications to check the results with different specifications. The results are summarized in Table 4.15 below, shows the second stage land holding certificate has had a significant and positive impact on land productivity in all specifications except in the last residual certificate, which is positive but not significant. This may indicate that the residual certificate variable failed to predict well. The direct OLS estimation (on the matched households) and instrumental estimation(on the full sample) give us very cloth results in terms of magnitude, sign and level of significance, this may be considered as evidence of the certification program is random, which means plot and household level characteristics does not matters for participation.

Table4.15 productivity impacts of second level land holding certificate

VARIABLES	*OLS(Actual certificate)[a]*	*IV(Actual certificate)[b]*	*OLS predicted certificate [c]*	*OLS on predicted certificate[d]*	*IV regression (Certificate residual)[e]*
certi_type2	**0.917****	**1.046****			
	(0.464)	**(0.458)**			
certi1			**1.147****		
			(0.507)		
certi2				**1.036****	
				(0.477)	
Rcerti3					**-0.839**
					(1.854)
Sex of the household head, 1= male, 0= female	0.918	0.973*	0.964*	0.964*	0.864
	(0.575)	(0.547)	(0.575)	(0.576)	(0.580)
Age of household head	-0.0388*	-0.0415**	-0.0411**	-0.0412**	-0.0381*
	(0.0204)	(0.0191)	(0.0201)	(0.0201)	(0.0203)
Education of the household head, 1=literate, 0=illiterate	0.226	0.295	0.299	0.295	0.250
	(0.534)	(0.504)	(0.530)	(0.531)	(0.535)
Number of adult male's for the household	0.280	0.269	0.267	0.269	0.252
	(0.221)	(0.209)	(0.220)	(0.220)	(0.222)
Number of adult female for the household	-0.149	-0.145	-0.149	-0.146	-0.150
	(0.230)	(0.219)	(0.231)	(0.231)	(0.233)
Own farm size in "Tsimdi"	0.585	0.377	0.385	0.376	0.295
	(0.390)	(0.342)	(0.360)	(0.360)	(0.361)
Average distance from plot to homestead	0.00295	-0.156	-0.155	-0.158	-0.175
	(0.163)	(0.136)	(0.143)	(0.143)	(0.144)
Number of years plot possessed	0.0240	0.0320	0.0312	0.0318	0.0337
	(0.0357)	(0.0338)	(0.0356)	(0.0356)	(0.0359)
Dummy of household have first stage certificate	0.594	0.733	0.722	0.731	0.779
	(0.693)	(0.652)	(0.686)	(0.686)	(0.692)
Soil type: *Ba'ekel*	0.585	0.510	0.508	0.503	0.483
	(0.836)	(0.790)	(0.831)	(0.831)	(0.839)
Soil type: *Walka*	0.178	0.124	0.131	0.121	0.00742
	(0.577)	(0.547)	(0.576)	(0.576)	(0.579)
Soil type: *Hutsa*	0.767	0.654	0.671	0.660	0.592
	(0.738)	(0.695)	(0.731)	(0.732)	(0.738)
Slope: Flat	-1.652	-1.393	-1.396	-1.382	-1.141
	(1.054)	(0.985)	(1.036)	(1.037)	(1.040)
Slope: Steep	-1.003	-0.678	-0.697	-0.673	-0.429

	(1.022)	(0.964)	(1.014)	(1.015)	(1.017)
Soil depth: Shallow	-0.871*	-0.982**	-0.977**	-0.980**	-1.026**
	(0.494)	(0.468)	(0.492)	(0.492)	(0.496)
Soil depth: Deep	0.943*	0.815*	0.810*	0.812*	0.793
	(0.486)	(0.457)	(0.481)	(0.481)	(0.486)
Number of oxen for the household	0.391*	0.469**	0.478**	0.468**	0.387**
	(0.200)	(0.187)	(0.197)	(0.196)	(0.195)
Tropical livestock unit for the household	-0.0297	-0.0265	-0.0271	-0.0267	-0.0236
	(0.0274)	(0.0260)	(0.0274)	(0.0274)	(0.0276)
Remittance received	1.301**	1.349**	1.313**	1.349**	1.418**
	(0.633)	(0.601)	(0.633)	(0.633)	(0.638)
Number of contacts with DA and visits	-0.143	-0.183*	-0.170	-0.173	-0.105
	(0.116)	(0.106)	(0.110)	(0.111)	(0.109)
Cooperative Members	4.021***	4.096***	4.097***	4.101***	4.006***
	(0.468)	(0.440)	(0.462)	(0.463)	(0.465)
FFW participate	0.0147	-0.0980	-0.111	-0.119	-0.0896
	(0.488)	(0.460)	(0.484)	(0.485)	(0.490)
Dummy manure use for plot, 1=yes, 0=otherwise	0.968**	0.937**	0.959**	0.936**	1.012**
	(0.459)	(0.436)	(0.458)	(0.459)	(0.462)
Dummy Public investment received plot, 1=Yes, 0=No	0.963*	1.140**	1.126**	1.140**	1.188**
	(0.542)	(0.512)	(0.539)	(0.539)	(0.544)
Fertilizer used in value (Ethiopian Birr)	-0.00034	-0.00035	-0.0004	-0.0005	-0.00026
	(0.00027)	(0.00026)	(0.00027)	(0.0003)	(0.00027)
Improved seed used in value (ETB)	-0.00064	-0.0005	-0.000581	-0.0005	-0.0006
	(0.00078)	(0.00075)	(0.0008)	(0.00079)	(0.0008)
Constant	1.527	1.637	1.580	1.637	1.885
	(1.479)	(1.384)	(1.458)	(1.457)	(1.466)
F(25, 251)	*6.17*	*6.15*	*6.19*	*6.17*	*5.90*
Prob>F	*0.00***	*0.00***	*0.00***	*0.00***	*0.00***
Observations	*275*	*279*	*279*	*279*	*279*
R-squared	*0.403*	*0.397*	*0.400*	*0.399*	*0.388*

Note: a OLS estimation using actual certificate variable on the matched households

b Standard IV estimation using year with certificate and village dummy as instruments (full sample)

c two stage estimation(predict certificate from observable household characteristics using the linear probability model then using this predicted certificate in estimation of the outcome equation).

d same as model in c but predict certificate from both plot and household characteristics

e the residual =the actual certificate – predicted certificate from model d(time invariant household and plot characteristics) used as weak instrument

Standard errors in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

Source: own survey, 2013

Overall, the above result confirms that certified households have significant gains from certification in terms of productivity. This is consistent to descriptive part and with the finding by Bezabih et al. (2012) in Amhara region in Ethiopia, Ghebru et al. (2008) in north Ethiopia and by Deininger et al. (2011) in Amhara region of Ethiopia.

The positive and significant (except OLS) coefficient for sex of the household head indicates that male headed households are operating optimally as comper to their counterparts. The lower

productivity of females also indicates that female headed households may lack the necessary factors of production to work their farms efficiently. Other variable that were consistently significant and with negative sign, is age of the household head, which shows older households are less productive. Litterateurs related with also supports this finding (see Mintewab Bezabih and Stein Holden, 2010; Lopez, 1997)

Of the plot characteristic, soil depth used as proxy for soil fertility, is important determinant of productivity. Deep soil type, which can be considered as fertile soil, have positive and significant correlation with yield whereas, plots with shallow soil depth associated with lower yields. The number of oxen for the household is positive determinant of productivity. This may be due to land size in Raya Azebo was larger as compared to the other parts of Tigray and large number of oxen may be relevant to cultivate plot on time and the increase productivity in one hand and the income received through renting oxen, which is common in Raya Azebo, which may have positive impact with productivity through income effect. This is also consistent to the one done by Mintewab Bezabih and Stein Holden (2010).

Other variable that was consistently significant with positive sign was plots with public investment. This indicates plots that receives public investment have better productivity level as compared to plots without public investment, suggests that investment such as soil bound or stone terraces have significant role on fostering land productivity.

The positive coefficients for the input variable manure shows that plots that use manure are more productive as compared to plot that does not use manure. This is expected and supports the finding done by Bezabih et al. (2012). Households who receive national and international remittance also performed better productivity. This is significant at 5 percent level of significance. Similar effect was observed from cooperative members. That household who was members of the farmer's association/cooperative performs better productivity as compared to their counterparts. This may be due to members are receiving different agricultural equipment, modern inputs and technical supports easily, nearest to their home stated with fair price which enhances productivity.

Finally we run the productivity model by incorporating the all specifications of investment equation to test the indirect impacts of certificate through this investment variable. Here two stage estimation, LPM in the first stage model since the coefficients of the predicted residuals from the first stage estimation are used. The other right hand variables includes plot and household characteristics and first stage models with and without certification are check. The predicted residuals from the different specifications of the regressions are included as explanatory variable in second stage estimation to check the simultaneity of the investment variables. Results shows that all the predicted residuals investment variables except in stone terrace which shows statistically significant which are an indication of no problem of simultaneity. Results of all investment variables and only the exogenous soil bound and tree seedlings investment variables with and without certificate are reported in the annex (9).

Investment variable in all specifications are not statistically significant except the endogenous stone terrace even after controlling for endogeneity of investment. The residual generated from the first-stage investment equation is also not significantly different from zero except the residual from the stone terrace estimation. These results imply that investments on farmlands appear not to enhance tenure security in Tigray and that the reverse causation of tenure security impacting on investment seems non-existent.

With these specifications certificate variable remained insignificant even if it is positive except in the specification where certificate variable are excluded in the first stage estimation. The parameter values for the certification variable were not only insignificant but also reduced in both specifications of these models indicating that some of the positive effect from the certification on land productivity may have come through these investment variables. The additional effect from certification may have been in terms of more use of variable inputs on plots with certificate which is beyond the scope of the study. Result details are in annex 9.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study tried to explore the impacts of parcel based second level land holding certificate on tenure security, investment and land productivity in Tigrai, northern Ethiopia.

The government of Ethiopia together with development partners has been undertaking field testing exercises to improve and update the previous land certification program in Raya Azebo and Tahtay Adyabo wereda of Tigray Regional State since January 2009. Community-level data shows that total of 13,815 households (12,299 from Raya Azebo and the remaining 1516 households from Tahtay Adyabo) and 25,690 parcels receive the second stage certificate.

The Land certification in Tigray/Ethiopia was different from land title programs that have been implemented in many other countries. The rights that are provided by the Ethiopian land certificates are much more restrictive as the land is still state property, the right to sell or mortgage land is prohibited by law and the right to rent out the land is no more than three consecutive year's duration only and applies to maximum half of the farm size. The user right may also be withdrawn from households migrating for more than two years and from households that fail to cultivate the land. Still, it appears that these land certificates have contributed to enhance the tenure security of households and this appears to have stimulated certain types of investment and land productivity.

Based on the empirical evidence emanating from this study, the following conclusion can be extracted and summarized as follows:

Our result shows that, respondents were clearer as to whether certification would protect them against future land redistribution or land taking by local government or in the course of urban expansion and agricultural investment. 86% of respondents were eager to get their certificates quickly so as to be able to use them in court and thus bolster the case for getting compensation. Similarly, 88% of the respondents perceives certificate improve women's position and tenure security, 82 % of respondents perceived that certificate make land market easy and secure.

Considerable households of the non certified respondents, 46.4% percent state that it was impossible for a counterclaim to challenge their claim. Whereas, 83 percent of the respondents from the treated group can considered as secure enough since they can counterclaim for owner ship of the plot.

In relation to investment in improving the existing conservation, Most of the household from both groups (73%) improve the existing soil bound or stone terrace. Majority of the households believe investment on land (soil bound and stone terraces) enhance land productivity. 62 percent of the household from the control group and 89 percent from treated group adopt soil bound in the last 18 months and it is statistically significant and consistent to the hypotheses. Moreover, 19 and 34 percent of respondent households from the control group and the treated group respectively, have adopted new stone terrace in the last 18 months. There is no significant difference in intensity of soil bound and stone terrace constructed structure in the control and treated group similarly, 82 percent of Non-certified households and 76 percent of certified household plot, receive public investment. 83 percent of the Non-certified households and 77.7 percent of certified household perceive tree planting enhance tenure security and majority of the households have shown their interest to plant tree in their plot even if it is legally prohibited.

Total values of output produced per hectare, shows that yield appear to be higher on plots with certificate than on plots without certificate even if the difference is not very large.

The results from the econometric estimation suggest that second level land holding certificate is meant to enhance perceived tenure security. This is consistent to the literatures done on impacts of first stage land certificate on tenure security in different parts of Ethiopia and in line to the descriptive evidence that points majority of the households from the treated village have better perceived tenure security as compared to households from non-treated villages. From this one can conclude that second level land holding certificate have significant role on building of the perception of tenure security in countries like Ethiopia with land redistribution experienced under successive governments and having proclamination that guarantees for every individual over the age of 18 years will have access to rural land if he/she desires to engage.

Using a double hurdle model, this estimates adoption decision and intensity of adoption separately. Since the alternative Tobit model rejected in favour of the double hurdle model, we

found that, second level land holding certificate pointed to statistically significant impacts on decision to adopt soil conservation bound and stone terrace. the treated households has had 8.5 percent more likely to investing soil bound and 12.6 percent more likely to investing stone terrace as compared to the households from the control village. This finding also supports the finding done by Ghebru et al. (2008) and Deininger et al. (2011). Surprisingly, the second level land holding certificate affects intensity of investment for both soil bound and stone terrace negatively and significantly, which indicate that decision to invest is higher in the certified households but among the household who pass the first hurdle (those who already invest) the intensity of investment is higher in the non certified households.

The results of different alternative certificate variable via number of tree seedlings shows that, the certificate variable in both specifications had no significant effect on number of tree seedlings planted in private plot. Although the signs of the coefficient estimates are consistent with the expectation, there is no compelling statistical support for this hypothesis. This may be related to the law restrictions on tree planting on arable land, especially for eucalyptus in addition to the recentness of the program.

Results from both parametric and non parametric estimation of productivity function indicates that the second level landholding certificate have had positive impact on land productivity in non parametric and all specifications of parametric except in the last residual certificate, which is positive but not significant. But in case of the non parametric estimation it lacks statistical significance in majority of the matching estimators, this may be due to matching drops respondents who are not matched to the treated households and may not be representative of the population. This may indicate that the residual certificate and the non parametric estimation failed to predict well. Overall, the parametric result confirms that certified households have significant gains from certification in terms of productivity.

The results of this research not only will allow policymakers to make changes as individual programs evolve but also will provide lessons for countries like Ethiopia that are struggling to make land policies more effective.

5.2 Recommendations

Based on the finding of the study the following policy recommendations are given

- The results from the probit regression of tenures security shows that second level land holding certificate have significant impact in households to feel certain to cultivate the same field in future and negative and significant impact for fear of land taking. It is also clear that these regions are working towards increased (rural) tenure security in an innovative way. The first phase is progressing so quickly, that it has already changed the land administration scenery in the region. And although some more attention should be given to the updating process started in some piloting to address over the region, develop better security among rural households of the region in particular and all over the country in general.

- Results from the descriptive analysis and own observation indicates that the main determinant of insecurity are the memory of redistribution of land in the recent past as government continuously changes and the provision in the land laws that anyone aged 18 years and above has a right to get rural land freely are the basic sources of land tenure insecurity and anxiety among the rural population. Clear legislation in the regional proclamations that there will be no further forced redistribution of land and restriction of applicability of 18 years and above aged of free land in fully settled and utilized areas and fair valuation of land and lengthy and adequate compensation for land taken under the powers of eminent domain and for private investors, publicizing this widely will enhance tenure security much more effectively rather than land certification alone.

- The Results in this study also demonstrates that, the second level land holding certificate pointed to statistically significant and economically meaningful impacts on decision to adopt soil conservation bound, stone terrace and land productivity. We therefore, call for policy measures in the proposed regional rural land registration and surviving programme that will enhance tenure security to facilitate investment in agricultural lands since individuals are more likely to invest in land if their plot is registered and certified. Such policies should focus on establishing a more effective and efficient land registration and certification system that will remove the bottlenecks in the land investment and enhance individual tenure security.

- Results from the truncated estimation show also intensity of adoption was negatively associated with certificate. This may be due to other potential variables rather than certificates are important on intensity of investment. Thus, in line to certification processes rural developments policies should give attention to other potential determinants of intensity of investment, which are highlighted by the large number of statistically significant variables in the models, to achieve the dual objectives. Polices should aim not only on encouraging farmers decision to adopt but also encouraging on intensity of investment.

- Furthermore, Tree growing was negatively but not statistically significant associated with certificate in Tigray and this may be related to the law restrictions on tree planting on arable land, especially for eucalyptus and the program is recent. Nevertheless, these restrictions have not been able to prevent the positive incentive of investment on tree planting in the non certified villages which shows the issue of insecurity is more sensitive than the laws behind the restrictions. There is also a reason to question the rationale of restricting such tree planting on very marginal arable land where production of annual crops is likely to be less sustainable than growing of trees and where tree production is much more profitable than crop production. So policies related with restriction of such investment should take in to consideration the comparative advantages of tree planting and should be flexible.

- User fees, however minimal, should be introduced so that people value the certificates and the security they afford them. Perhaps, the willingness to pay in average was around 54 birr and payment norm prepared by the ministry of agriculture was 61 birr per parcel (which is around 162 birr per household) which is difficult to cover, but still partially offset the initial investment in land certification and recover the costs of maintaining the cadastre and make it sustainable over the long-term is better.

- In general, this study confirms that tenure security and investment benefits are observed, especially as other factors, which allow such effects to materialize (e.g., household characteristics, and plot level characteristics), come into play, they can easily be undermined if the beneficiaries' lose confidence in the value of the certificates. This is highlighted by the

large number of statistically significant variables in the models, each marginally contributing to tenure security and the overall decision to invest, as well as to the decision on how much to invest and land productivity. A lesson for policymakers is that major changes in tenure security, land conservation investments and land productivity will require attention to all these factors because no single factor can be used as a major policy leverage instrument.

- Some of the variables such as land taking by the government whether for urban expansion, outside investors, or internal redistribution without land title certificates to determine compensation levels or award compensation could jeopardize the credibility of the certificates. On a more technical level, failure to keep registration of land titles up to date would have the same effect and can be directly influenced by government policies and programs.

5.3Issues for Further Research

Additional research is needed to determine whether such programs have affected tenure security, investment and land productivity.

Certification can potentially also affect productivity indirectly via effects on the use of modern input and manure. In other words, modern input use and manure may be correlated with the certification variables. This needs deep investigation and should be addressed in future research. It is, however, outside the scope of this paper

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Annexes

Annex 1. Description of variables used for regression analysis:

variable name	Description
• certi_type2	Dummy of household have PBSLLH certificate for his plot
• Certificate year	Year with certificate
Dependent variables	
Tenure Security indicators	
• cert_after5	certain owner feels certain to cultivate the same field after 5 years, 1=Yes, 0= No
• fear_lgrab	Dummy owner fear his land may taken by the gov't at any time
Investment indicators	
• Treeseedlings	Number of tree planted after certification(last 18 months)
• deci_invSWC	Dummy adopt soil bound
• inte_swc	Density of soil bounds constructed (meters)
• ST_adopt	Dummy adopt stone terrace
• int_ST	Intensity Stone terrace constructed (meters)
Productivity indicator	
• totvalha	total value of output per ha
• logtotvalha	log of total value of output per ha own plot
Household characteristics	
• sexhh	Sex of the household head, 1= male, 0= female
• agehh	Age of household head
• age2	Age square of household head
• educhh	Education of the household head, 1=literate, 0=illiterate
• adumale	Number of adult male's for the household
• adufem	Number of adult female for the household
• depratio	Dependence ratio
• own_land	Own farm size in "Tsimdi"
• oxen	Number of oxen for the household
• tlu	Tropical livestock unit for the household
plot level characteristics /factors	
• no_parcel	Number of parcels for the household
• plotdist	Average distance from plot to homestead
• plot_age	Plot age

• public_inv	Dummy of whether there has been public conservation on the plot
• first_certi	Dummy of household have first stage certificate for his plot
• bak_type	Soil type: *Ba'ekel*
• walk_type	Soil type: *Walka*
• hut_type	Soil type: *Hutsa*
• mek_type	Soil type: *Mekeyih*
• slop1	Slope: Flat slope
• slop2	Slope: moderate slope
• slop3	Slope: steep slope
• sd_shallow	Soil depth: Shallow
• sd_medium	Soil depth: Medium
• sd_deep	soil depth: Deep
Tenure security variables	
• ts_improv	Status of tenure security in the last 2 years, 1=Improve, 0=No change,
• likely_coucliam	-1=Reduce plot, 1=impossible, 2=Unlikely, 3=likely
• land_redi	Dummy Owner feel land redistribution taken next five years
Interaction variables	
• intetree_TS	interaction variable
• iner_invPro	interaction variable
Socio –institutional factors	
• extecona	Number of visits and community meeting called by DA hh attend
• cooperative	Cooperative member Dummy, 1= member,0= otherwise
• ffw_parti	FFW participate dummy, 1= if benefiters, 0=otherwise
Input variables	
• remittance	Remittance received
• manure	Dummy manure use for plot, 1=yes, 0=otherwise
• fertvalue	Fertilizer used in value (Ethiopian Birr)
• seedvalue	Improved seed used in value (Ethiopian Birr)
• naturaltree	Number of natural trees in the plot
• youngtree	Number of young trees in the plot

Annex 2. Overview of Variables Used In the Analysis with Basic Statistics

Variables	*Full sample*		*Non certified*		*Certified*	
	Mean	***Std. Dev.***	***Mean***	***Std. Dev.***	***Mean***	***Std. Dev.***
Treatment variable	.4157706	.49374	0	0	1	0
Year with certificate	.7221027	.916518	0	0	1.732471	.5156856
owner feels certain to cultivate the same field after 5 years, 1=Yes, 0=No	.5125448	.5007408	.2638037	.4420522	.862069	.3463236
Dummy owner fear his land may taken by the gov't at any time	.4695341	.4999678	.7177914	.4514613	.1206897	.3271796
Number of tree seedlings planted last 18 months	88.95341	201.9558	111.1288	238.1641	57.7931	130.4432
Dummy adopt soil bound	.7311828	.4441414	.6196319	.4869734	.887931	.3168198
soil bounds constructed (meters)	160.3297	227.4547	165.6871	244.6787	152.8017	201.5741
Dummy adopt stone terrace	.2544803	.4363514	.190184	.3936557	.3448276	.4773741
Stone terrace construction (meters)	12.39427	69.96553	11.14724	81.43362	14.14655	49.8656
Total value yields per hectare (in Ethiopia birr)	3201.835	6866.349	2852.395	7004.793	3692.859	6665.974
Log of value of output in hectare	4.180672	4.17859	4.001161	4.144456	4.432916	4.231171
Sex of the household head, 1=male, 0= female	.8028674	.3985482	.8220859	.383619	.7758621	.4188225
Age of household head	47.83513	13.54136	46.79755	13.14833	49.2931	14.00249
Age of household head square	2470.91	1403.044	2361.828	1349.727	2624.19	1466.915
Education of household head dummy, 1 if hh can read and write or attended any formal school, 0, illiterate	.2150538	.4115979	.2208589	.4161039	.2068966	.4068381
Number of adult males for hh head	1.548387	1.05103	1.588957	1.004496	1.491379	1.11508
Number of adult females for the hh head	1.587814	.981114	1.539877	.9178975	1.655172	1.064065
Dependence ratio	2.288249	1.330594	2.229871	1.265886	2.370279	1.418074
Own farm size in "Tsimdi"	5.340502	2.873942	5.503067	3.081955	5.112069	2.54873
oxen Number of oxen for the household	1.358423	1.199757	1.564417	1.257259	1.068966	1.052733
Tropical livestock unit for the household	4.772577	8.248836	4.922301	4.704747	4.56219	11.54253
Number of parcels for the household	1.749104	.6187632	1.723926	.650625	1.784483	.5718929
Average distance from plot to homestead	1.968871	1.533713	2.078563	1.657252	1.814734	1.332813
Plot age	17.51075	7.874403	16.9274	7.841052	18.33046	7.881857
Dummy of whether there has been public conservation	.2007168	.4012564	.1717791	.3783507	.2413793	.4297763

on the plot Dummy of household have first stage certificate	.8458781	.3617143	.8159509	.3887184	.887931	.3168198
Soil type: Ba'ekel	.0824373	.275524	.0858896	.2810644	.0775862	.2686799
Soil type: Ba'ekel	.6845878	.4655148	.7116564	.4543877	.6465517	.4801143
Soil type: Ba'ekel	.1827957	.3871935	.1840491	.3887184	.1810345	.3867172
Soil type: Ba'ekel	.2616487	.4403222	.2638037	.4420522	.2586207	.4397764
Slope: Flat	.8996416	.3010172	.8895706	.3143902	.9137931	.281887
Slope: Medium	.0501792	.2187069	.0613497	.2407102	.0344828	.1832572
Slope: Steep	.1326165	.3397692	.1349693	.3427438	.1293103	.3369988
Soil depth: Shallow.	4265233	.4954604	.4417178	.4981219	.4051724	.4930552
Soil depth: medium	.3297491	.4709667	.3312883	.472127	.3275862	.4713692
Soil depth: deep	.516129	.5006378	.5337423	.5003975	.4913793	.5020946
Status of tenure last 2 years, 1=Improve, 0=No change,1=Reduce	.4910394	.5989427	.3374233	.6108167	.7068966	.5110474
Owner counterclaim about the ownership of the plot, 1=impossible, 2=Unlikely, 3=likely , 4= not sure	2.28777	.9556566	1.969136	.993287	2.732759	.6897732
Dummy Owner perceive land redistribution taken next five years	.3763441	.4853385	.4355828	.4973611	.2931034	.4571603
Interaction variable	.2759857	.4478128	.3128834	.4650962	.2241379	.4188225
Interaction variable	.6666667	.4722516	.5460123	.4994127	.8362069	.3716933
Number of visits and community meeting called by DA hh attend	1.551971	2.075028	1.153374	1.712636	2.112069	2.394819
Cooperative member dummy, 1= member,0= otherwise	.5125448	.5007408	.5276074	.5007757	.4913793	.5020946
FFW participate	.311828	.4640724	.2760736	.4484313	.362069	.4826837
Remittance received	.1469534	.3546957	.1165644	.3218894	.1896552	.393729
Dummy manure use for plot, 1=yes, 0=otherwise	.4551971	.4988835	.398773	.4911548	.5344828	.5009736
Fertilizer used in value (Ethiopian Birr)	738.0986	871.0875	618.4525	799.8521	906.222	940.3549
Fertilizer used in value (Ethiopian Birr)	124.0394	284.1993	113.5951	267.9023	138.7155	306.2264
Number of natural trees in the plot	18.10753	85.325	20.99387	89.09736	14.05172	79.92723
Number of young trees in the plot	29.09319	117.1335	34.71166	121.3151	21.19828	111.0286

Annex 3. Summery Statistics of Variables Used In the descriptive statistics

Questions asked to sample household	**Non-certified**	**Certified**	Full sample
How likely counterclaim for owner ship of the plot?			
Impossible	46.39	10.71	**32.01**
unlikely	14.46	4.46	**10.43**
likely	34.94	83.04	**54.32**
No-change	4.22	1.79	**3.24**
Is there any improvement of tenure security enhancing measure taken place within the last 2 years			
Worsen/reduced	7.78	1.79	**5.38**
No change	50.90	24.11	**40.14**
Improve	41.32	74.11	**54.48**
Certain	35.93	87.50	**56.63**
Do you feel that having a certificate will increase the possibility of obtaining compensation in case the land is taken?			
No	0.60	0.00	**0.36**
Yes	89.22	91.07	**89.96**
Not sure	10.18	8.93	**9.68**
Do you believe that having a land certificate improves the tenure security of women?			
Yes	88.02	88.39	**88.17**
No	11.98	11.61	**11.83**
Does having a certificate make you more willing to rent out the land to strangers?			
No	17.96	16.96	**17.56**
Yes	82.04	83.04	**82.44**
Do you think that having land certificate make land market easy and secure? 1=Yes, 0=No			
No	17.96	13.39	**16.13**
Yes	82.04	86.61	**83.87**
What type of tenure arrangement do you prefer?			
Privet Ownership	20.36	25.89	**22.58**
State Ownership	78.44	73.21	**76.34**
No Idea	1.20	0.89	**1.08**
Certificate reduce border conflict			
Yes it have	81.6	87.93	**84.23**
I don't think so	14.72	10.34	**12.90**
Never	3.68	1.72	**2.87**
Believe certificate reduce conflict related with in heritance			
Yes	95.71	95.69	**95.7**
Never	4.29	4.31	**4.30**
Interested in planting tree on any one of your plot.			
No	23.35	26.79	**24.73**
Yes	76.65	73.21	**75.27**
Believe certificate encourage to plant tree			
No	31.33	32.14	**31.65**
Yes	68.67	67.86	**68.35**
Think tree planting enhance tenure security			
No	16.17	22.32	**18.64**
Yes	83.83	77.68	**81.36**
Interested in adoption of soil bound constructed in his plot			
No	8.38	4.46	**6.81**
Yes	91.62	95.54	**93.19**

Are u interested in adoption of ST in any one of your plot.			
No	63.47	56.25	**60.57**
Yes	36.53	43.75	**39.43**
Is there any SWC bound or STC made before 18 months			
No	35.33	27.68	**32.26**
Yes	64.67	72.32	**67.74**
Made any improvement in the existing of SWC or STC in the last 18 months			
Worsen	5.39	5.36	**5.38**
No change	20.96	21.43	**21.15**
Improve	73.65	73.21	**73.48**
Believe investment on land enhance productivity			
Yes	7.19	6.25	**6.81**
No	92.81	93.75	**93.19**
Public investment			
Yes	82.04	76.79	**79.93**
No	17.96	23.21	**20.07**
You or a member of your family attend			
No	47.71	34.23	**42.05**
Yes	52.29	65.77	**57.95**
Number of meetings attend	**1.131737**	**1.776786**	

Annex-4 Measuring Spillover Effects of Program Placement

```
      Source |       SS       df       MS              Number of obs =     167
-------------+------------------------------           F(  1,   165) =    0.54
       Model |   .1344642     1    .1344642            Prob > F      =  0.4620
    Residual |  40.8236196   165  .247415877           R-squared     =  0.0033
-------------+------------------------------           Adj R-squared = -0.0028
       Total |  40.9580838   166  .246735445           Root MSE      =  .49741


------------------------------------------------------------------------------
  inv_type2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  progvillf |   .1855828   .2517377     0.74   0.462    -.3114595    .6826252
      _cons |   .5644172   .0389601    14.49   0.000     .4874926    .6413418
```

Annex 5.Logit estimation for participation in the certification program

pscore *certi_type2 sexhh agehh educhh adulthh own_land plotdist plot_age first_certi bak_type walk_type hut_type slop1 slop2 slop3 sd_shallow sd_deep oxen_2003 tlu_2003 youngtree SWC_2003 STC_2003, pscore(ps13) blockid(blockf1) comsup numblo(5) level(0.001)* ***logit***

```
************************************************

Algorithm to estimate the propensity score
************************************************
The treatment is certi_type2
      Dummy of
  certificate  |       Freq.     Percent        Cum.
---------------+-----------------------------------
No certificate |        163       58.42       58.42
   Certificate |        116       41.58      100.00
---------------+-----------------------------------
         Total |        279      100.00
```

Estimation of the propensity score

```
Iteration 0:   log likelihood = -189.41034
Iteration 1:   log likelihood = -180.03865
Iteration 2:   log likelihood =  -179.9173
Iteration 3:   log likelihood = -179.91711

Logistic regression                               Number of obs   =     279
                                                  LR chi2(20)     =     18.99
                                                  Prob > chi2     =     0.5227
Log likelihood = -179.91711                       Pseudo R2       =     0.0501
------------------------------------------------------------------------------
 certi_type2 |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       sexhh |  -.2019937   .3425613    -0.59   0.555    -.8734016    .4694141
       agehh |    .013868   .0118475     1.17   0.242    -.0093527    .0370887
      educhh |   .0539247   .3243889     0.17   0.868    -.5818658    .6897152
     adulthh |   .0391765   .0904928     0.43   0.665    -.1381861    .2165391
    own_land |  -.1160193     .05906    -1.96   0.049    -.2317747   -.0002639
    plotdist |  -.1106197   .0932755    -1.19   0.236    -.2934363    .0721968
    plot_age |   .0151612   .0214275     0.71   0.479    -.0268359    .0571584
 first_certi |   .4622918   .4220351     1.10   0.273    -.3648818    1.289466
    bak_type |  -.0559994    .496848    -0.11   0.910    -1.029804    .9178049
   walk_type |  -.5356318   .3481641    -1.54   0.124    -1.218021    .1467573
    hut_type |   .0658319   .4606702     0.14   0.886    -.8370651    .9687289
       slop1 |   .7731895   .6507257     1.19   0.235    -.5022094    2.048588
       slop3 |   .6729651     .62606     1.07   0.282      -.55409     1.90002
  sd_shallow |  -.4050932   .2998521    -1.35   0.177    -.9927926    .1826062
     sd_deep |  -.1374403   .2919623    -0.47   0.638    -.7096759    .4347952
   oxen_2003 |  -.0380259   .1068069    -0.36   0.722    -.2473635    .1713117
    tlu_2003 |   .0122561   .0160342     0.76   0.445    -.0191702    .0436825
   youngtree |  -.0012474   .0012856    -0.97   0.332     -.003767    .0012723
    SWC_2003 |  -.0003772   .0005992    -0.63   0.529    -.0015516    .0007972
    STC_2003 |   .0020384   .0023929     0.85   0.394    -.0026517    .0067285
       _cons |   -.947692   .8823373    -1.07   0.283    -2.677041    .7816574
------------------------------------------------------------------------------

Note: the common support option has been selected
The region of common support is [.19059294, .76650343]

Description of the estimated propensity score in region of common support
 Estimated propensity score
      -------------------------------------------------------------
```

```
      Percentiles      Smallest
 1%     .1984121       .1905929
 5%     .2290153       .1940486
10%     .2671907       .1984121       Obs                 275
25%     .3383497       .2027955       Sum of Wgt.         275

50%      .408238                      Mean            .420558
                       Largest       Std. Dev.      .1207908
75%     .5026219       .7005928
90%     .5838325       .7449281       Variance       .0145904
95%      .623517       .7475521       Skewness         .32175
99%     .7449281       .7665034       Kurtosis       2.615963


*****************************************************
Step 1: Identification of the optimal number of blocks Use option detail if you
want more detailed output
*****************************************************
```

The final number of blocks is 5

This number of blocks ensures that the mean propensity score is not different for treated and controls in each blocks

```
**********************************************************
Step 2: Test of balancing property of the propensity score Use option detail if you
want more detailed output
**********************************************************
```

The balancing property is satisfied

This table shows the inferior bound, the number of treated and the number of controls for each block

Inferior of block of pscore	Dummy of household have PBSLLH certificate for his plot: No certif	Certifica	Total
.1905929	2	1	3
.2	83	42	125
.4	48	30	78
.5	16	32	48
.6	10	11	21
Total	159	116	275

Note: the common support option has been selected

```
****************************************
```
End of the algorithm to estimate the pscore
```
****************************************
```

Annex 6. Conversion factors used to estimate tropical livestock units (TLU)

Livestock category	Conversion Factor
Camel	**1.4**
Horse	**1.1**
Ox	**1**
Cow	**1**
Woyfen (weaned male calf)	**0.34**
Heifer	**0.75**
Calf	**0.25**
Donkey (adult)	**0.7**
Donkey (young)	**0.35**
Sheep (adult)	**0.13**
Sheep (young)	**0.06**
Goat (adult)	**0.13**
Goat (young)	**0.06**
Hen	**0.013**

Source: Storck, et al., 1991

Annex 7. ATT results of intensity of soil bound constructed

Matching method	No. Treated	No. Control	ATT	Std.Err	t-value
Stratification	116	159	-3.153	27.592	-0.114
Nearest neighbor	116	58	-78.750	59.186	-1.331
Radius	112	153	-18.929	31.964	-0.592
Kernel	116	159	-0.824	25.758	-0.032

Annex 8. ATT results of intensity terrace constructed:

Matching method	No. Treated	No. Control	ATT	Std.Err	t-value
Stratification	116	159	0.231	11.181	0.021
Nearest neighbor	116	58	1.724	16.832	0.102
Radius	112	153	2.415	7.314	0.330
Kernel	116	159	-2.948	12.948	-0.228

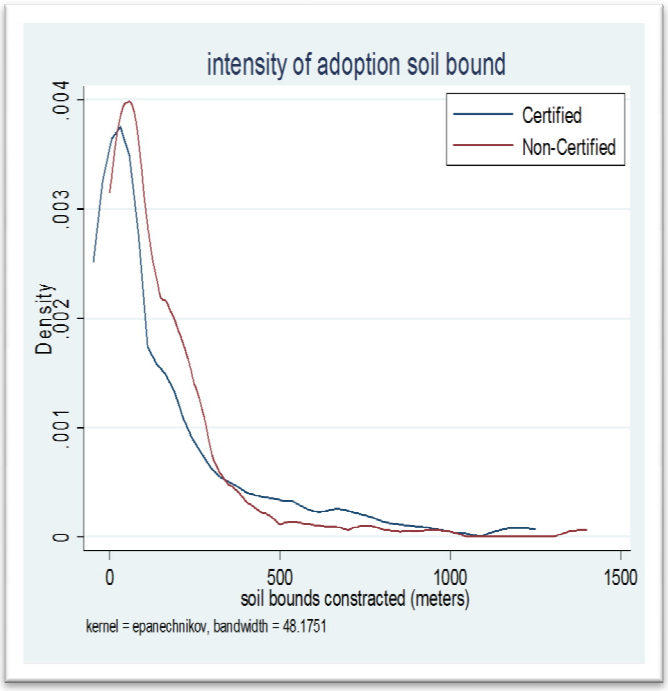
Annex 9 indirect impacts of certificate (through investment) on productivity with alternative options

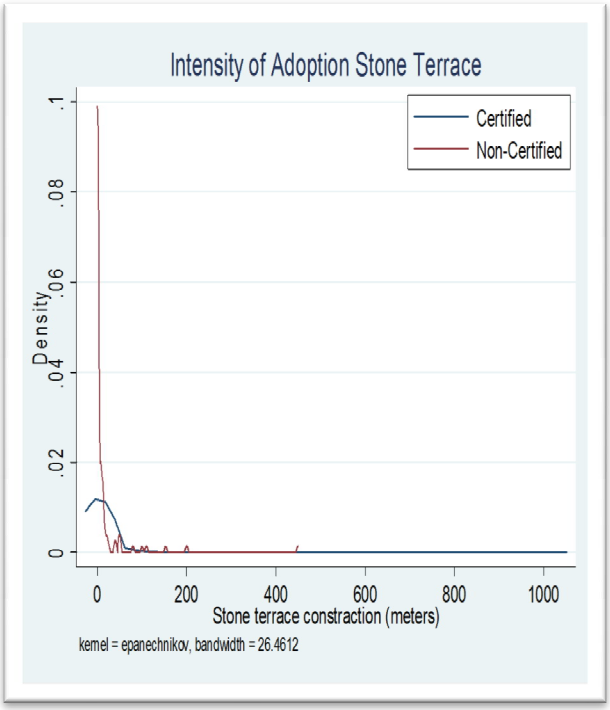
VARIABLES	Two stage excluding endogenous stone terrace from first stage	Two stage including certificate from the first stage	Two stage excluding certificate from the first stage	OLS on reduced form equation
certi_type2	0.821	0.690	0.792*	0.917**
	(0.503)	(0.504)	(0.467)	(0.464)
sexhh	1.050*	1.023*	1.026*	0.918
	(0.589)	(0.587)	(0.589)	(0.575)
agehh	-0.0369*	-0.0546**	-0.0557**	-0.0388*
	(0.0210)	(0.0227)	(0.0230)	(0.0204)
educhh	0.314	0.501	0.501	0.226
	(0.537)	(0.542)	(0.542)	(0.534)
adumale	0.265	-0.0693	-0.0718	0.280
	(0.221)	(0.277)	(0.277)	(0.221)
adufem	-0.111	-0.0703	-0.0739	-0.149
	(0.236)	(0.235)	(0.234)	(0.230)
own_landha	0.514	0.798*	0.815*	0.585
	(0.392)	(0.414)	(0.417)	(0.390)
plotdist	-0.0856	0.0618	0.0674	0.00295
	(0.187)	(0.201)	(0.200)	(0.163)
plot_age	0.0170	0.0154	0.0162	0.0240
	(0.0367)	(0.0365)	(0.0365)	(0.0357)
first_certi	0.720	0.673	0.662	0.594
	(0.704)	(0.701)	(0.699)	(0.693)
inte_swc	0.00155	0.00146	0.00130	
	(0.00169)	(0.00168)	(0.00168)	
int_ST		0.0331**	0.0334**	
		(0.0165)	(0.0164)	
Treeseedlings	-0.00391	-0.00570	-0.00563	
	(0.00437)	(0.00444)	(0.00430)	
bak_type	0.835	1.220	1.224	0.585
	(0.876)	(0.892)	(0.891)	(0.836)
walk_type	0.264	0.106	0.114	0.178
	(0.584)	(0.587)	(0.590)	(0.577)
hut_type	0.967	1.333*	1.323*	0.767
	(0.752)	(0.770)	(0.768)	(0.738)
slop1	-1.780	-2.009*	-2.033*	-1.652
	(1.081)	(1.082)	(1.088)	(1.054)
slop3	-1.029	-0.903	-0.920	-1.003
	(1.019)	(1.016)	(1.016)	(1.022)
sd_shallow	-0.923*	-1.174**	-1.163**	-0.871*
	(0.498)	(0.512)	(0.513)	(0.494)
sd_deep	0.985**	1.472***	1.478***	0.943*
	(0.487)	(0.541)	(0.541)	(0.486)
oxen	0.420**	0.413**	0.419**	0.391*
	(0.203)	(0.202)	(0.202)	(0.200)

tlu	-0.0317	-0.0326	-0.0322	-0.0297
	(0.0274)	(0.0273)	(0.0274)	(0.0274)
remittance	1.204*	1.175*	1.164*	1.301**
	(0.652)	(0.649)	(0.649)	(0.633)
extecona	-0.129	-0.126	-0.130	-0.143
	(0.135)	(0.135)	(0.129)	(0.116)
cooperative	4.014***	3.918***	3.919***	4.021***
	(0.469)	(0.471)	(0.471)	(0.468)
ffw_parti	-0.100	-0.0829	-0.0744	0.0147
	(0.497)	(0.496)	(0.494)	(0.488)
manure	0.991**	0.987**	0.989**	0.968**
	(0.457)	(0.456)	(0.457)	(0.459)
public_inv	0.915*	0.994*	0.993*	0.963*
	(0.541)	(0.540)	(0.540)	(0.542)
fertvalue	-0.000339	-0.000299	-0.000298	-0.000337
	(0.000272)	(0.000272)	(0.000272)	(0.000272)
seedvalue	-0.000717	-0.000747	-0.000745	-0.000639
	(0.000790)	(0.000787)	(0.000787)	(0.000784)
e1	-0.00136	-0.00131		
	(0.00208)	(0.00208)		
e2		-0.0346**		
		(0.0168)		
e3	0.00100	0.00274		
	(0.00464)	(0.00469)		
res_1			-0.00106	
			(0.00208)	
res_2			-0.0350**	
			(0.0167)	
res_3			0.00267	
			(0.00455)	
Constant	1.676	2.256	2.254	1.527
	(1.550)	(1.568)	(1.552)	(1.479)
Observations	275	275	275	275
R-squared	0.417	0.427	0.427	0.403
Prob > F	0.000	0.000	0.000	0.000

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

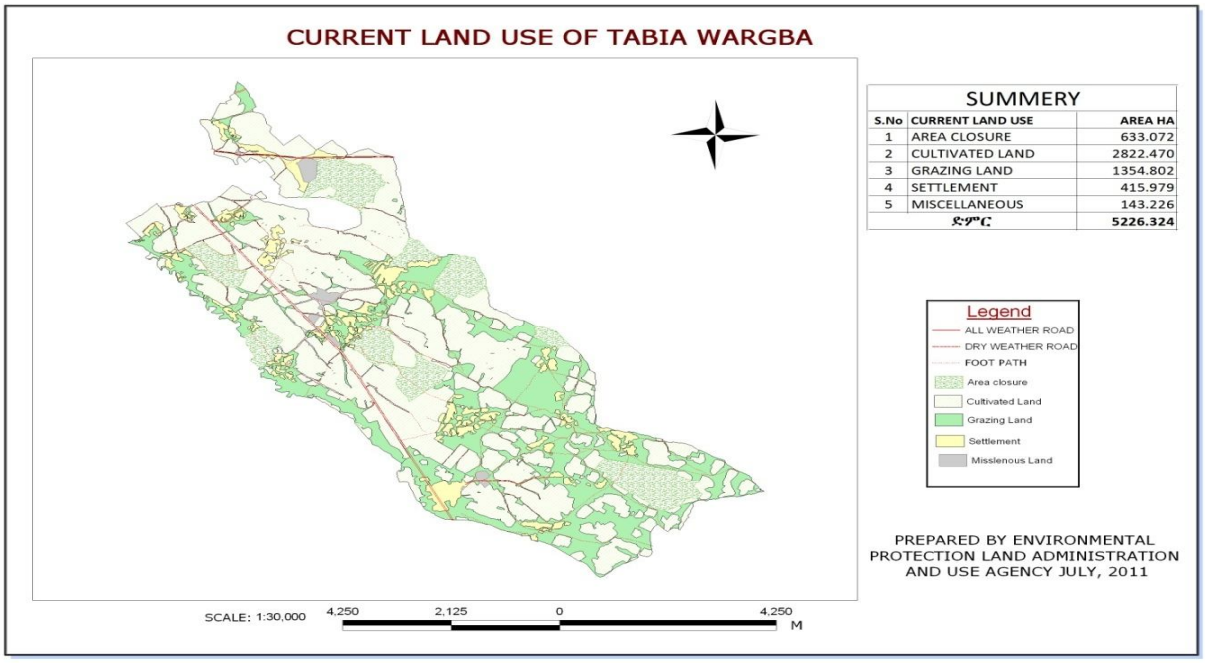
Annex 10 Kernel density graph intensity of adoption of SWC and ST for plots with and without land certification (matched sample)





A two-sample Kolmogorov-Smirnov test for equality of distribution functions for intensity of investment for soil bound and stone terrace was highly Significant (P=0.000 and 0.04, respectively) indicating that the distributions were different.

Annex 11 sample of current land use of treated tabia (Wargba)



Annex 12. Survey Instrument Used in This Study

Assessing "Socio-Economic Impacts of Parcel Based Second Level Landholding Certificates: Evidence From Northern Ethiopia"

Good morning/ afternoon. My name is _____. We are doing a research to develop an academic study about the socio-economic impacts of parcel based second level land holding certificates. I would like to count on your cooperation to understand the socio-economic impacts of the program.

Questionnaire number:

Woreda _____

Tabia _____

Kushet_____

Tibia's distance from woreda market _____Tibia's distance from woreda town _____

Tibia's distance from asphalt road _____Tibia's distance from gravel road _____

Name of the interviewee: _____

Interviewer_____

Date of interview _____

Checked by _____

Data entry by _____

Household ID code _____

Parcel ID code/code of certificates _____

Respondent gender _____ age _____ education _____ Religion_____

Category I: Household Demographics

A. Provide the details of each household member

We would like to ask a few questions about all members of the household. Please include everybody who usually lives in the household (including servants etc)

Member ID	1.Name of the household member	2.Relationship to household head Code (a)	3.Sex Male..... 1 Female.... 0	4.Age	5.Marital status Code (**b)**	6.Education level Code (d)	7. Main occupation (what is the name of profession or activity? Code (c)	8.Secondary activity (name)	9. How many months did the name live here in the last 12 months
01									
02									
03									
04									
05									
06									
07									
08									
09									
10									

(a)relationship with household		**(b)martial stats**	**(C) occupation**	**(d) education**
1 Husband/Wife 2 Partner/Cohabite 3 Natural son/daughter 4 Stepson/stepdaughter 5. Son-in-law/daughter-in-law 6 Step-father/mother 7 Half-brother/sister 8 Step-brother/sister	9 Brother/Sister-in-law 10 Grand-parent 11 Cousin 12 Aunt/Uncle 13 Niece/Nephew 14 Other relative 15 Employee 16 Employer 17 Other non-relative	1 Single and never married or never in a legally recognized civil partnership 2 Married 3 Widowed 4 Separated but legally married 5 Divorced 6 too young to marred	0 = none 1=farming 2=business 3=laborer 4=unemployed 5=student 6=child 7= other (specify) _____	0 too young to attend (child) 1-12 for those who attained formal school 13 college diploma or technical/vocational level 14 first degree and above 15 never attained any formal school but can read and write 16 illiterate(never attend formal school and cannot read and write) 17 other Specify.....

Category II: Household Asset: land and livestock

Section A: Own Land

A.1 Total area of cultivated land that the household have _____ (tsimdi)

A.2 How many parcels does the household have? _____

1.Plot Name	2.Plot size	3.Distance from home to the plot	4.When did you obtained this plot/age of the plot	5.How did you acquire this plot	6.Do you have the first stage land certificate (belbal) kiti'e	7.Do you have the second stage land certificate	8.If yes, when did you obtained this certificate (2^{nd} stage)	9.What is the slope of the plot	10.What is the general texture/soil type of the plot	11.What is the general depth of the soil	12.Soil quality (subjective report)
01											
02											
03											
04											
05											
				1=generated local leaders 2=inherited 3=rented 4=farming as tenant	Yes=1 No=0	Yes=1 No=0		Flat=1 Foot hill=2 Mid hill=3 Steep hill=4	1=Ba'ekel 2= Walka 3=Hutsa 4= Mekeyih	1=Shallow, 2=Medium, 3= Deep	1=Fertile 2=Medium 3=Poor

B. Livestock ownership

Can you tell me about your heard of livestock at present?

Type of livestock	1.Number owned and present at home	2.Number owned and present at home in summer 2011(kremti 2003)	3.Did you buy any ...(...) during the last 18 months			4.Did you sell any ...(...) during the last 18 months			5.During the last six months how many were born?
			a.Number bought	b.Total purchased vale of all bought	c.Financing of the purchase **(code a)**	a.Number of sold (if none write 0)	b.Total sales values of all sold	c.Reasons for sold **(code b)**	
Young bulls/oxen									
Cows									
Heifer / Calves									
sheep									
Goats									
Horses/ Mules									
Camels									
Donkey									
Beehives									
poultry									

(a)Financing purpose

Income from farm 1
Other income 2
Income from sale of livestock 3
Income from sale of asset 4
Saving 5
Loan/gift from relative 6
Other specify.....

(b)Reasons for sale

To help relatives 1
To buy food.....2
To buy other goods 3
To buy seeds 4
To buy livestock 5
To pay for labor 6
To repay loans 7
To pay tax 8
To buy building material.....9
To pay for health expense 10
To pay for education expense 11
Other 12
Specify.....

C. Livestock yield

Livestock product	1.How much of the livestock product have you produced since the last four months (write "0" if product was not produced)	2. How much of this product did the household use for consumption since the last four month?	3. How much of this product did the household sell since the last four months?	4. How much of this product did the household give to other HHs the last four months?	5. How much of this product did the household currently have in storage?
Milk (L)					
Butter(kg)					
Eggs (#)					
Hides/skins(#)					
Honey(kg)					
Other					

Category III: Land registration and certification process.

A. **Participation in the program and awareness creation.**

1. Were public information meetings held before the land registration program started? 1 yes, 0= no **(if no go to Q-4)**

2. Did you or a member of your family attend any of these meeting? 1=Yes, 0=No **(if no go to Q-4)**
3. How many of these meeting did you or a member of your family attended? .....
4. How do you evaluate the efforts made by government (woreda or regional level) to make you aware about the second stage land certification? 1= Good enough 2= Not enough at all 3= Difficult to explain 4= No response
5. Is any one of your family or you member of the land administration committee? 1=Yes, 0=No

Category IV: Issues Related to Tenure Security and Land Related Disputes

1. Who will inherit this plot from you?

1=Oldest son/daughter, 2=Oldest son, 3=Oldest daughter, 4=Youngest unmarried son/daughter, 5=Unmarried son, 6=Unmarried daughter, 7=Favorite son, 8=Favorite daughter, 9=other family members, 10=the village, 11=don't know, 12=other specify

2. Who can grab the land away from you?
   1 =Village Chief 2= Brother/in law /Sister/ in law 3=None 4=Owner
   5= government 6.....Other (specify).....
3. What measures do you take to ensure (that) NOT lose the plot?
   1=Plant tree 2=fallow 3= leave for grazing
   4=registered 5=none 6=other (specify).....
4. Did you have the parcel based second level landholding certificate for your plot?
   1=Yes 0=No **(Go to Q-6)**
5. If YES, in whose name was it?
   1= head 2=joint (husband and wife) 3=both son and daughter
   4= joint plus list of family members 5=other (specify).....
6. **If No,** why not? 1=Land registration was not held in our district
   2=I did not want the certificate, 3=I refused to get for the certificate, (go to Q-10)
   4=I have not yet been given the certificate I should have,
   5= Did not submit photos yet, 6=Difficult to get photos, 7=Expensive,
   8=Other, specify _____
7. If you refused to receive or NOT volunteer to get the certificate, what were the reasons? 1=Certificate is only a piece of paper and has no value 2=Certificate does not provide tenure security 3=Certificate may cause me to have to pay more tax,
   4=other, specify:
8. If you don't have a certificate, would you prefer to receive a new land certificate with a map of each of your plots, with clear identification of the location and size and shape of the plot? 1=Yes, 0=No
9. **If yes,** how much would you maximum be willing to pay for it or how many man days are you maximum willingness to work for the kebele to obtain such certificate?
10. Have you had any border conflicts on the plot? In the last 18 months? 1= Yes 0= No
11. What type of conflict is common in your vicinity?
    1= Border disputes 2=Plot ownership 3= Inheritance dispute
    4=Divorce disputes 5=Other, specify.....
12. Where was this conflicts resolved?
    1=LAC 2=Village chief 3=Byto (tabia Court)
    4=DA 5=wereda court 6= Negotiation by old villagers

13. Are the borders of your plots clearly demarcated?
    1=yes, 0=no
14. Is there any change in border disputes related to your land in the last 18 months?
    1= less disputes 2= no difference, 3= more disputes
15. Do you think that the second level land registration had any effect on reduction of border disputes related? 1= yes it have 2= I don't think so 3 =Never
16. **Only for Certified Respondents,** How was land border conflict **during** the implementation of the program? 1= less disputes 2= no difference, 3= more disputes
17. Does having a certificate protect you against encroachment on your land by neighbors? 1=Less risk of encroachment, 0=No difference
18. How do you evaluate the level of land dispute in the last 18 months in your community? 1= worsened/ increase, 2= no change, 3= improve
19. Are border disputes a great concern for you? 1= Yes, 0=No
20. In your opinion what type of measures should be taken to mitigate land dispute? _____ _____ _____.
21. Has the land registration and certification had any effect on the amount of inheritance disputes in your community?
    1=More inheritance disputes 2=No change 3=Less inheritance disputes
22. Do you think that you will cultivate the same field after five year?
    1= yes/ certain/ sure 0= I do not think so (not)
23. Do you think there will be any new land redistributions in your kebele within the next five years? 1=Yes, 0=No
24. Do you fear that your land is taken by the government at any time?
    1= Yes, I fear 2. No I don't fear 3= no response
25. Is there any improvement of tenure security enhancing measure taken place within the last 2 years about ownership of the land?
    1=improve 0= no change -1= worsen or reduce.
26. Do you believe that your holding right is secured as result of certificate of holding?
    1=Yes, 1=No, 3= No response
27. How likely you can counterclaim for ownership of the plot?
    1=Impossible 2= unlikely 3= likely 4= no change
28. Do you feel that having a certificate will increase the possibility of obtaining compensation in case the land is taken? 1=Yes, 0=No, 2=Not sure
29. Do you believe that having a land certificate improves the tenure security of women?
    1=Yes, 0=No, 2=Not sure
30. Do you believe that having land certificate will reduce the number of conflicts related to inheriting land to children? 1=Yes, 0=No, 2=Not sure

31. If your land were suddenly demanded for public purposes by the tabia, how much compensation, minimum, would you consider being a fair compensation for losing your land? _____birr
32. If it became legal to sell land, would you consider sell the land if you got a good price? 1=Yes, 0=No, 2=Only if I came in a desperate situation,
33. If you were allowed to sell your land and are willing to sell it, how much would be the minimum acceptable price for you to sell it now? Price without value of your house and other buildings on your land (cultivated land only). _____birr
34. Does having a certificate make you more willing to rent out the land to strangers? 1=Yes, 0=No
35. Do you think that having land certificate make land market easy and secure? 1=Yes, 0=No
36. What type of tenure arrangement do you prefer? 1=Privet Ownership 2=State Ownership 3= No Idea

Category V: Gender Issues

1. Have you been married before? 1= Yes, 0= No (Go to Q-4)
2. If yes, what was the reason for the break? 1= divorce, 2= death of partner.
3. If yes, how much land do you get after divorced? _____ tsimdi
4. Do you have TDAR today? 1= Yes, 0= No
5. In case of divorce today, how much of the land you and your wife/husband would get? _____ 1= Equally shared with my spouse 2= Less than half appropriated to husband 3= less than half appropriated to wife 4= I don't know
6. In case of divorced, what would females do with their land in your community? 1= share crop it 2= crop it themselves(with help of son) 3= rent it out for money, 4= other
7. In case of the divorced, how many of the children are expected to stay with you? 1= all 2=none of them 3= some of them (**age and sex those with wife, indicate it in table A**) 4=do not have children 5= don't know
8. Do you think that your wife or you (if the respondent is wife) have strong land right after the new land certification? 1= Yes, No = 0
9. Is there any change in relation to ownership of plot? 1= Yes, No = 0
10. Do you agree with the following rules?

i. Joint title of husband and wife? 1= Yes, 0= No
ii. Equal sharing of land upon divorce? 1= Yes, 0= No
iii. Only wife's name on certificate, if second and third wife of polygamous men? 1= Yes, 0= No
iv. Females should be allowed to plough the land? 1= Yes, 0= No

11. How do you perceive the regulation that the wife also should have her name and picture on the certificate? 1=Indifferent (acceptable), 2=Good, 3=Bad

12. Does the wife's name on the certificate, affect her power over the land?
    1=Has no effect, 2=She has a stronger position in case of divorce or husband's death, 3=She involves more in land-related decisions within marriage (e.g. crop choice and input use), 4=She controls more of the income from production on the land, 5=She is involved in land-renting decisions, 6=She does more work on the land, 7=other, specify_____
13. Does it matter how much land you brought into marriage, for how much you get in case of divorce? 1=It does not matter, equal share always, 2=Only land obtained during marriage is shared equally, 3=Inherited land is kept by the individual, other land is shared equally, 4=You can keep land that has been allocated to you as an individual, 5=Other, specify
14. Do your wife (you) get remittance from relatives that is earned in the last four months? 1= Yes, (by whom? a=husband side b= wife c= both) 0=No **(Go to Q-16)**
15. How much did you get remittance in the last four months? _____
16. Can family members deny the (male) head of household to rent out their family land? 1=Yes, if they want to, 2=Yes, but only the wife, 3=No
17. Is there a Land Administration Committee in your Tabia? 1.Yes, 2=No, 3=Don't know
18. If yes to Q#17, did you participate in the election of the committee? 1=Yes, 0=No
19. If yes to Q#17, is there a reservation for female members in the land administration committee? 1=Yes, 0=No, 2=Don't know
20. If yes to Q#19, what is the minimum number of female members that has to be placed in the land administration committee? _____
21. If yes to Q#19, are there female members in the current land committee of the Tabia? 1=Yes, 0=No, 2=Don't know
22. If yes to Q#19, are you a member of the land administration Committee? 1=Yes, 0=No
23. Put the options below on who decides the following issues.

    1=husband 2=husband and wife 3=wife 4= other_____

23.1 Daily household need	
23.2 Large household purchase	
23.3 Land rent out/share cropping if needed	
23.4 Adoptions of modern input/fertilizer	
23.5 Improved seed adoption	
23.6 Left fellow	
23.7 Type of crop/seed selection	
23.8 Decisions on credit	

24. Perceived Family Background of wife (relative):_____ 1=poor 2=medium 3=rich
25. Put your level of agreement on: 'a husband is justified in beat his wife for each of the following reasons': 0=no 1=yes
    a. if she burns the food;_____
    b. if she argues with him;_____
    c. if she goes out of the house without telling him; _____
    d. if she neglects the children_____

26. Is there credit access reserved for women in your tabia? _____0=no 1=yes

27. Had the wife borrowed money from any institution in the last 2 years? __ 0=no 1=yes

28. What was the amount of asset brought to marriage by the side of the wife? _____ birr, _____ in kind.

29. Who controls majority of the income of the household? 1=husband 2=wife 3=equal 4=other _

30. Who decides on the income of the household? 1=husband 2=wife 3=equal 4=other specify__

31. Do you believe that you are equal with your spouse? 0=no 1=yes

32. Do the community perceive equality of men and women? 0=no 1=yes

33. Do women themselves perceive that they are equal with men? 0=no 1=yes

34. Why_____

Category VI: Investment on plot

1) Are you interested in planting trees on any of your plots? 1= Yes, 0 =No
2) Did you plant tree in your plot in the last 18 months? 1= Yes, 0 =No
3) Does having the land certificate increase your incentive to plant tree? 1= Yes, 0 =No
4) Do you think that tree planting enhance tenure security/reduce the probability of losing land? 1= Yes, 0 =No
5) Are you interested in adoption of SWC bound in your plot? 1= Yes, 0 =No
6) Did you made any SWC bound in the last 18 months? 1= Yes, 0 =No
7) Are you interested in adoption of STC in your plot? 1=Yes, 0=No
8) Did you made any STC in any of your parcel in the last 18 months? 1=Yes, 0=No
9) Is there any SWC bound or STC made before 18 months in your plot? 1= Yes, 0 =No
10) Did you made improvements on your farm land for the existing SWC or STC to improve in the last 18 months? improve =1, no change =0, worsened/reduce = -1
11) Do you think that investment on plot (SWC and STC) enhance/improve productivity? 1= Yes, 0 =No
12) Is there any public investment of SWC bound or ST construction made in any one of your parcel/plot in the past 18 months? 1= Yes, 0 =No (Go to the table)
13) If **yes** please estimate the approximate total meters (how many in meters) of those investments in your own entire plot? _____
14) Is there any pressure from community to invest on your plot any type of investment? 1= Yes, 0 =No
15) Reasons for investment on land **(possible to answer more than one)**

Improve soil quality = 1 Incentives given = 2
Advice from extension workers = 3 Perceives Increase yield (productivity) = 4
Perceives Control soil erosion = 5 Perceives Reduce probability of losing land = 6
Pressure from community = 7 Other (Specify) _____

16. Investment on plot

Plot name/ID	1.Number of natural tree in plot(write 0 if none)	2.Number of young tree planted before 18 months in plot	3. If Q-1 is yes, Did you plant tree in your plot in the past 18 months	4. How many trees are there? Number	5.Length of SWC bound constructed before 18 months in your plot(write 0 if none)	6. Did you made any SWC bound in the last 18 months	7. How much (Intensity) in meter	8. Length of ST constructed before 18 months in your plot (write 0, if none)	9. Did you invest any STC in the last 18 months	10. How much (meters)
01										
02										
03										
04										
05										
06										
			1= yes 0=no			1= yes 0=no			1= yes 0=no	

Category VII: Input use

The input questions refer to all crops as a whole.

7.1 Total area of land cultivated during the last summer (2012)_____(in tsimdi)

7.2 Total area of land cultivated during the last summer (2012) on which fertilizer was used_____(in tsimdi)

7.3 Total area of land covered by improved seed during the last summer (2012)_____(in tsimdi)

	1. Did you use any manure from your household herd on your fields? Yes = 1 No = 0	2. Did you purchase any fertilizer for use on your fields?				3. Did you purchase any improved seed for use on your fields?				4. Number of household visits and community meetings called by DA attained by the household members in the last 6 months.	5.Did you apply and get loan in the past 12 months Yes = 1**(amount pls?)** No = 0	6.Did you belongs to a farming organizations(cooperative Yes =1 No = 0	7.Participates in off-farm income in the last 18 months	8.Receipt national or international remittance in the last 18 months
		a.Yes =1 N = 0	b.Amount	c.Unit	d.Total value	a.Yes=1 No = 0	b.Amount	c.Unit	d.Total value					
7.4 Total														

7.5 Did you participate in food/cash for work activities in the last 18 months? Yes ☐ No ☐

The questions refer to all the land on which crops were harvested during the last season.

Activity	1.plowing	2.Weeding	3.Harvesting
7.6 How many days did you do this activity (labor cost)			
7.7 Oxen days			

7.8 Do you have irrigable land? 0=no 1=yes

7.9 If your answer for the above question is yes, how much? _____tsimdi

Category VIII: Crop output and sales market

For each crop harvested during the last season (kiremt 2004 E.C) can you answer the following questions?

8.1 For permanent crops, mention the harvest during the period since the beginning of September 2004 E.C

Plot name	1.Crop code(a)	2.How much was you Harvest during the last (kiremt)		3. Have you sold any part of this harvest? Yes.....1 No .....0,next crop	4.If you sale any part of your harvest, answer questions on amount and revenue		
		a. Quantity	b. Unit(b)		a. Amount	b. Unit (b)	c. Total revenue (Birr)
01							
02							
03							
04							
05							
06							

(a) Crop code

White teff 1
Black and mixed teff 2
Barley 3
Wheat 4
Karka'Eta 5
Maize 6
Sorghum 7
Oats 8
Beans 9
Linseed 10
Groundnuts 11
Sesame 12
Pulses 13
Lentils 14
Vegetables (kosta, selata).....15
Chat 16
Banana, papaya, orange 17
Grass 18
Geshu 19
Eucalyptus 20
Potatoes 21
Onion 22
Tomato 23
Guava (zeytuna).....24
Sugarcane.....25
Zengada (lequa) 26
Other 27
Specify.....

b)Quantity unit		
Kilogram 1	Silicha 7	Kubaya 13
Quintal 2	Bermil 8	Birchiko 14
Chiret/keshkesh.....3	Litters 9	Gembo 15
Loketa 4	Ensira 10	Birr 16
Kafer 5	Minelik 11	Others 17
Mishe 6	Shember 12	Specify .....

8.2 How do you evaluate the productivity of your farm lands in last two years?

1= decrease 2=the same as before 3=shows increasing trend 4= difficult to explain

8.3 Reasons for the above

_____

_____

_____

8.4 What other factors influence the productivity of your farm?

_____

_____

_____

_____

CHECK LEST QUESTIONS

Cadastral principles

1) Is your cadastral system based on deeds registration or on title registration?

   1= Deeds registration 2= Title registration

   3= Other..... 4= Specify_____

2) By law, is registration of land ownership compulsory or optional?

   1=Compulsory 2= Optional 3=Others.....

3) If felt necessary, please, comment on the actual practice and the legal consequences.

   _____

   _____

   _____

   _____

Approach for the establishments of the cadastral records

4) Are landowners required to register their properties systematically during the initial establishment of the cadastre or is registration sporadic, i.e. triggered only by specific actions (such as for example sale)?

   1=Systematic (regular) 2= Sporadic (irregular)

   3= Both 4=All properties are already registered

   5=Other.....

5) What is the population of the wereda(one of the wereda) _____

6) Please estimate the approximate total number of smallest uniquely identified land units, often called “land parcels” in your wereda/ tabia(depending on the respondent)
7) What the approximate total number is of registered in terms of house hold?
8) Please estimate the distribution between the smallest uniquely identified land units, often called, “land parcels”

   (i) That are legally registered and surveyed, ----------

   ii) That are legally occupied but not registered or surveyed, ----------

   (iii) That is informally occupied without any legal title ----------

9) Total number of professional land surveyors, such as licensed surveyors active within the cadastre system? _____
10) Proportion of the time that these land surveyors commit for cadastral matters:_____
11) Total number of lawyers/solicitors or equivalent active within the cadastral system:_____
12) Proportion of the time that these land surveyors commit for cadastral matters:_____
13) Whose name would it be written in the second level land holding certificates name list as owner?

   1= head 2=joint (husband and wife) 3=both son and daughter

   4= joint plus list of family members 5=other (specify).....

14) What type of communication means do you use to disseminate information? 1= radio 2=TV 3= news paper 4= conferences (#) if any please _____ 5= other (specify)
15) Is there a statutory system of land registration which records rights in land, including ownership, in a public register?
16) If there is, please list the main laws which govern land registration?
17) Who is authorized to independently supervise or audit the operation of the Land Registration?
18) Does the head of the Registration office have statutory powers to decide, from evidence and documentation provided, questions of land ownership, and the benefit and the burden of other rights affecting land - or is the Registry simply a place of record of legal facts and documents ? (please specify)
19) Does the act of registration confer legal status on the rights in land? (The legal status is determined by lawyers who investigate and provide an opinion on the quality of the title)

20) Are the Land Rights that are registered guaranteed by the State or by any other means (please specify)?
21) Can an approved enquirer obtain a copy of any register or map of a registered property?
22) Is registered land related to a map indicating the extent and the boundaries of the property?
23) Are boundaries determined precisely by co-ordinates or are they determined by general Boundaries in relation to a topographic map? Specify or choice one of the following way;
    1. By co-ordinates in the digital cadastral map
    2. By measured data in field sketches, or
    3. By representation in graphical map only.
24) Which organization is responsible for maintaining the survey and mapping of registered properties? Specify it at wereda, regional and national level please?
25) Does the law or any regulation require that unique reference numbers are used for registered land? (Please specify).
26) To what extent is the cost of maintaining the land registration system financed by fees paid by customers or by the regional and federal government funding (indicate relative percentage)? Government funding .....%, Fees paid by customers .....%, other means .....% (please specify).
27) Are fees set under the provisions of the law or regulations, (please indicate any legal provision that governs the setting of fees)?
28) Does the law specify any formal relationship or co-ordination between the organizations responsible for registering land rights, cadastral survey and mapping, land valuation and land use? (Please describe and how is responsible for each task)
29) Is it possible to obtain the welfare classification list of household in each tabia? (classification shows livelihood poor, middle and relatively richer households)
30) Number of land distribution taken please after 1991? ----------
31) Population density of each tabia?
32) Number of households live in each tabia?
33) Number of households who haven't land in each tabia?
34) Latitude of each tabia/wereda?
35) Average rainfall in each tabia/woreda?
36) Level of productivity of each tabia?

Annex 13 sample picture at the time of data collection

Annex14. Sample pictures of the study site and certification activities